JOURNAL OF GAS LIGHTING & WATER SUPPLY.

EDITOR & PUBLISHER: WALTER KING. OFFICE: 11, BOLT COURT, FLEET ST., LONDON.

VOL. CXXI., No. 2596.] TUESDAY, FEBRUARY 11, 1913. [65TH YEAR.

EDITORIAL NOTES.

The Unrestricted Coal Owner.

THE meeting of the Gaslight and Coke Company on Friday was one of the shortest we remember over a long series of years. This was rather surprising in view of the fact that the past half year, as was seen from our review of the accounts in last week's issue, was, as the Governor (Sir Corbet Woodall) said, one of unusual interest. But length of proceedings on such occasions does not always constitute weight; and Sir Corbet had something to say which, coming from the head of a concern carbonizing something like 2 million tons of coal a year, was particularly weighty, and cannot be overlooked by those to whom it was obviously addressed outside the proprietary. Though the Company's increase in gas business was of a character such as has not been experienced by the leviathan concern for seventeen years; though the revenue is of such huge proportions with a much lower price for the Company's staple commodity; though capital charges and many other expenses have been reduced per unit of output through skilful, alert, and solicitous administration, supplemented by the loyal working of officers and men—there are no extra fruits from this half year that stands ahead of so many previous half years in the magnitude of business. On the contrary, a part of the accumulations of previous half years have had to be appropriated to pay the dividend at the same rate as the preceding half year. Let us again mention the fact (which was also quoted by the Governor in his speech) that the half-year's increase of the Company's gas sales was equal to the total gas consumption in the Edinburgh and Leith areas of supply, and the character of the Company's operations in the half year is thereby at once better appreciated. Yet the greater part of the benefit of this and the increased revenue from residuals has been absorbed mainly by the extraordinary level to which the price of coal has been raised—coal has been far and away the main absorbing factor. Before the Governor reached the part of his speech which, in effect, constituted an appeal to the Government to step in and see whether something cannot be done to protect the country against the greed of the coal owners and their indifference to the interests of the country, there was patent a strong resentment that so large a part of the benefit of the immense accretion of business had been ingulfed in the manner that has been experienced. For the gas consumers there was but one laconic communication: "There "will be no reduction of the price of gas this year." For this, the blame must rest not upon the Company, but upon the coal owners.

The time has passed for reasoning with the coal owners. The lure of opportunity has carried them beyond the point of reason. The appeal now should be to the Legislature, and that appeal should be strongly supported by the home industries generally and by the people. The case is a strong one for intervention by the only power that can inflict control. The coal owners are under no obligations as between seller and buyer—no obligations as between seller and home buyer of a native commodity placed in this island by the bounty of Nature. The position of the coal owner was contrasted by the Governor with that of the gas industry. The Legislature insists on elaborate precautions for the protection of the consumers of gas in this country. Of that, no complaint is made. But, asks the Governor, is it not an anomaly that the suppliers of coal—the material from which gas is made, the material upon which light, heat, and power so largely depend, the material which is at the very root of the country's prosperity—are under no obligations whatever, and against them the country has no protection. Our statesmen and instructors in political economy talk a great deal about the question of the duration of our coal supplies; but it would be of more current benefit if they would pay some attention to the economic side of this coal question as bearing upon the country's commercial welfare. The last twelve months' experiences supply more than sufficient reason for the Government turning some of their attention from so-called social reforms to this matter of prime importance to the country's prosperity, convenience, and comfort. Before the great coal strike, home industry was taxed by higher prices for coal in making provision for the threatened stoppage; home industry was held up during the strike, and suffered much loss. Succeeding the strike home industry was sacrificed by the coal owners owing to a rush to satisfy foreign consumers who had other markets from which they could obtain supplies; and following this home industry was again, and still is being, sacrificed by prices higher than were and are justified. The conditions of trade now are such that for a time these prices are likely to be maintained. It is shallow and idle talk for the coal-owners to speak, in the present connection, of the operation of the laws of supply and demand. Their opportunity (from which they took more than their due) was the abnormal demand created by a strike of extraordinary duration and effects, and that strike has not been without a wealth of profit for them. It is obviously the Governor's view (and consumers of coal generally will agree with it) that the whole of the country and the country's industries should not be left the victims of the rapacity of a small section of the community.

It is a strong case, couched in the dignified language of one who keenly feels the position, that is presented for the intervention of the Government. In the interests of the country's industry, in the cause of the nation's economic welfare, it is their duty to inquire into the circumstances which produce such rapid and permanent rises in the price of coal as have been experienced during the past twelve months; and it is their duty to see that, in the event of shortage of supply, our home industries should receive primary and full consideration before coal is allowed to leave our shores. Home industry ought not to be hampered and taxed in any degree through the requirements of other countries. The plain duty of the Government is to investigate these matters, and to impose upon those who profit from our native stores obligations that will act as a safeguard to our national industries and prosperity. In urging this, the Governor was most opportune, and made the best possible use of the high position which he fills in the world of commerce, and in the large coal-consuming gas industry.

The Increased Cost of Living for Industry.

INVESTIGATING the half-year's report and accounts of the South Metropolitan Gas Company, one is struck by several points which supply sharp lessons for those who study contemporary industrial affairs. We are ever having pressed upon notice (and rightly so where the condition exists) the question as to the increased cost of living to those who are in the lower ranks of the community. Less is heard of the causes of this increased cost. Less still is heard of the increased cost to industry of living in these times. The one has a bearing upon the other; for higher costs in industry usually mean increased costs of its produce to the community. In the present accounts, item after item indicates how heavily fall certain of the incidents of modern times upon the Company (the Company being representative of numerous others), causing a higher cost of living for the concern. We see this substantially expressed in coal, and in the expenditure on the maintenance and renewal of the Company's property at the present market prices, and in the expenditure involved by labour. A considerable part of the additional cost of coal—£88,977—was due to abnormal prices; and repairs, maintenance, and renewals of works, distribution plant, and appliances for the utilization of gas cost, in the aggregate, a further £25,075. Whereas pensions and officers' and workmen's superannuation, sick, and accident funds involved a charge of £7774 in the second half of 1911, the superannuation, sick, and accident funds in the

past half year claim £13,261; and National Insurance Act charges, £2872. In contrast with the latter half of 1911, £2164 extra was paid in salaries, and a further £19,155 in wages—the total of the salaries being £42,819, and of wages £310,856. Part of these extra expenses are due to the work occasioned by the increased business; but the greater part of them may be attributed to heavier expenses attaching to the carrying on of industry. Fortunately for the Company's consumers, the business in all directions has expanded; but despite the many thousand pounds of extra revenue from gas, rentals, and residuals—the fruit of careful administration, assiduous developing work, and good markets—the Company came out of the half year showing a deficiency of £31,727 in profit to pay the dividend at £5 9s. 4d. per cent. per annum; but the deficit is to be made good from the balance in hand. In other words, the whole of the proceeds of the half-year's business growth, and the additional revenue yielded by the residuals markets, have been swallowed up in higher costs, and more was needed to strike a balance.

Some of the items of the accounts which represent the additional cost of living are not likely to recede; and hope rests upon a material reduction of the price of coal. The conditions of the half year also show that, in the interests of the consumers—a large proportion of whom are poor—nothing must be allowed to interfere with free trading in the residual products of gas manufacture. The Chairman of the Company (Mr. Charles Carpenter) and his co-Directors express their gratification at the report of the Joint Committee of Parliament who were entrusted with the duty of inquiring and reporting as to whether or not there should be any limitation placed upon the gas industry in regard to its dealings in residuals. The emphatic negative of the Committee, within the bounds of the operations that the industry desire to be kept open, was the wisest possible conclusion to the proceedings that resulted in their appointment. Had they arrived at the opposite conclusion, the decision might have had a sinister aspect for gas consumers, who in all probability would have had in many places—with the control of coal market prices by influences other than those supplied by the laws of supply and demand, and the market for gas residual products largely under the control of the chemical manufacturers—to provide additional revenue, and thus increase the amount of their expenditure on gaseous fuel for lighting, heating, cooking, and motive power. Should any of the members of the Joint Committee see the report of the Directors of the South Metropolitan Company, and consider the paragraph of it referring to the question of residuals in the light in which reference is made to the matter in this comment, they will derive added satisfaction from their judicial decision; for there is a very full meaning attaching to the words: "The deficiency would have been more "serious but for the enhanced value of the bye-products "of carbonizing in which tar and ammonia figure largely." The £45,891 increase in the receipts for residuals, through both higher values and the greater quantity of coal carbonized to meet the larger gas business, saved the situation for the gas consumers, though, of course, the fact that this sum had to go towards meeting the extra price of coal defers to that degree the opportunity for giving the consumers the benefit of a lower price for gas, or for conferring benefit through additional service for their and the Company's mutual benefit.

In both manufacture and business, the Company did extremely well in the half year. The period of local stagnation appears to have passed away; and there are the signs of new life throughout the area. The increase in the gas business appears to have been general in the Metropolitan area. The Company registered an increase of upwards of 6 per cent., or 382,043,000 cubic feet—the total sale of the half year having been 6,529,978,000 cubic feet. The increase was spread well over the six months—as a matter of fact, the larger part of it fell conveniently and economically into the Michaelmas quarter; for, in a total receipt for gas of £679,931, there was an increase of £36,450, of which £19,179 was contributed by the Michaelmas quarter, and £16,902 by the Christmas quarter—the small balance being made up by public lighting. To meet this increased demand for gas, an additional 31,924 tons of coal had to be used, in comparison with the second half of 1911—making the total quantity carbonized 559,074 tons; the cost having been £395,264, or an extra £88,977. This shows the serious effect of the higher price per ton of coal. The manufacturing department, however, did its share in alleviating the position by producing an average of 12,494 cubic feet of gas per ton, compared with 12,392 cubic feet in the corresponding half of 1911. Had the make per ton remained the same as in the corresponding half of the preceding year, to meet requirements a larger quantity of the dearer coal would have had to be purchased. While dealing with the flourishing state of the trading of the half year, it is pleasant to note that the signs are that this is not a mere flash in the pan, though confessedly the gas industry is controlled very largely in its accretions and decretions by atmospheric conditions, which are in these days of a vagarious order. Trade connections are increasing at a good pace. Meter and stove rentals and gas-fittings, yielding in the half year £118,539, represent an increase of £8214. The number of ordinary meters in use on Dec. 31 last was 95,898, or *one* less than on Dec. 31, 1911; while the slot meters totalled to 263,913, or 6349 more. Ordinary consumers' stoves on rent numbered 81,213, or an increase of 1514; and slot consumers' stoves, 217,460, or 6956 more. Gas-fires on hire rose, by 5000, to 38,309; but the number of privately owned gas-fires in the Company's area must now be considerable. This is an excellent state of things, which is supplemented by the large degree of favour that tradesmen of South London have bestowed upon the high-pressure gas system for exterior lighting and heightening the night attractions of their neighbourhoods. [A special article upon this subject appeared in the "JOURNAL" for Jan. 21.] On parade lighting, the number of lamps added during the past year was 1266; making the total, excluding all private isolated installations, 3136. The contribution of residuals to revenue got well on to half the receipts for gas; being £320,802, or (as was previously mentioned) £45,891 extra—the increase being supplied by coke, £24,882; breeze, £1246; tar and tar products, £9480; and ammonia products, £10,284.

Beyond what has already been said, there is not very much that calls for mention in connection with the expenditure side of the revenue account. The additional outlay on coal, so far as occasioned by the increased cost per ton, is the feature that belittles all others of the working outlay. The total manufacturing expenditure for the six months amounted to £628,371, or an increase of £108,399, of which £88,977 was due to coal, £2425 to purification, a moderate supplement to salaries, £3380 to wages, and £13,023 to repairs and maintenance of works. Touching purification, the Directors announce that the 10 million cubic feet plant for converting the sulphur compounds of the gas into sulphuretted hydrogen, which is then removed by oxide of iron, has been put into operation at the Old Kent Road station, and is fulfilling the expectations formed in regard to it. It is now proposed to extend the process throughout the Company's stations. In connection with distribution, £185,968 was spent, or an extra £12,430, practically all of which is accounted for under repairs, maintenance, and renewals of mains and services, meters, stoves, and fittings. The total expenditure was £945,609, or an increase of £129,661. The receipts amounted to £1,120,767; being the substantial advance of £90,461. Deducting expenditure from revenue, there is a balance of £175,158, or a drop of £39,200. The liability for this is principally upon coal. There are additional expenses attached to the business by changes in condition (partly and largely produced by parliamentary decrees, and to a less extent by the growth of business); but coal overshadows them all. In every respect, the Company's own trading has flourished during the half year; and in this the proprietors will find abundant satisfaction at the meeting to-morrow.

The Alliance of Gas and Electricity Supplies.

UNSOLICITED, an article reaches us for publication from Mr. C. H. Wordingham, M.Inst.C.E., whose high position in the electrical world claims for his views our respectful consideration. His main purpose in contributing the article to our columns is to present the case, as he sees it, for a closer alliance between the gas and electricity industries, by the former embarking upon the business of the latter as far as opportunity will allow. Let us say at once that there are economic considerations affecting the chief point of Mr. Wordingham's article, which enable us, without accepting all his submissions, to agree that, within limits, there is advantage for a district in concentrating the lighting, heating, and power supplies—both gas and electricity—in the hands of a single company. Recent sessions of Parliament

have shown that the gas industry has appreciated the favoured position it holds in this matter in, at any rate, those towns in which competition between gas and electricity supply authorities can only result in the maintenance, and not the reduction of, the prices of the commodities, if a fair dividend is to be earned upon the capital employed in both concerns.

Expert electrical engineers who have, when consulted by gas companies as to prospects, made a thorough investigation of the position, have—whether or not they disbelieved it previously or *a prima vista*—fully admitted, just as Mr. Wordingham now does after having investigated a case, that the superiority of position in the matter of economical working of an electricity supply lies with the established gas concern, and not with an independent electrical one, which, from the land for its generating plant to the points of its business connections, and its organization throughout, must be complete in itself. The Tottenham and Edmonton Gaslight Company is a case in point. So far back as 1896, they were contemplating adding the supply of electricity to their business; and they are in the coming session of Parliament taking an important step in carrying out their long-cherished ideas in regard to one part of their area. In 1896, Sir Alexander Kennedy was consulted by them; and he then, as Sir Corbet Woodall stated at the meeting of the Company last Saturday, was of opinion, though not greatly impressed by the character of the area for electricity supply, that an established Gas Company such as this could afford to provide current at a reasonable price for the limited demands likely to be found. A gas-works has generally land available, which can be utilized for generating plant; plenty of waste fuel is produced on the works which can be used for steam generation; and there should not be any place where gas-engines can be run more economically than on a gas-works. Many gas-works staffs now embrace a man qualified in electrical work, seeing that many gas-works employ electrical energy for the special purpose of propelling the retort charging and discharging machines and raising and lowering their mechanism, as well as supply gas for the driving of private electricity generating plants. Distribution, establishment, and other charges must also be lower, as in the gas-works and offices there is already the organization that such a business requires. Mr. Wordingham is so confident of this being a good economic proposition that he says that, for small towns and villages the advantages of a gas company undertaking the electric supply are "overwhelming."

All the capital and working economies that are to be derived from the established gas concern are in favour of the electricity consumer; all those economies represent added cost to the independent electricity-supply concern, and must be borne by its patrons. Therefore what may be made a profitable business in the hands of the established gas concern may be an unprofitable one in the hands of a separate electrical company; and, even if profitable, the consumers must suffer, and the expansion of the business must be retarded, by the necessarily dearer supply. The objections that have been urged from the electrical side against the union of gas and electricity businesses have been of a purely hypothetical character, and have had no foundation in fact. Stronger objections could probably be urged by gas undertakings against the union of electricity with their businesses, commencing with the element of speculation—anyway, during the first few years. But gas men are business men. They recognize that there are people who will have electricity; that there are purposes for which electricity is specially suited; and that sooner or later in all gas-supply areas there will be established an electricity supply. Therefore if there is any profit to be made from the business, they may as well make it, inasmuch as they can do it on the cheapest possible terms, and so mutually benefit those who require electricity and themselves. The only objection submitted by our electrical friends against the union of the two supplies which really calls for any notice is that the benefits of competition are destroyed, and therefore the consumers are deprived of the lower prices that are produced by competition. The electricity supply industry is the last quarter from which such an argument should come. It and the electrical manufacturing industry have both shown how competition can be, under certain circumstances, destructive and uneconomic, as well as, under other circumstances, beneficial.

The argument further shows the loose appreciation that apparently exists in the electricity industry of the conditions that rule in the gas industry. It must be quite clear to any thinking man that where the scope for business is limited, that scope, if profits are to be made by independent gas and electric undertakings, must have more influence than competition upon price, and that there must be a limit to the reduction of price which competition can possibly effect. Scope therefore discounts the power of competition in this particular. We have seen that the economies, under the conditions of combined working, should do more than any competition could possibly do for the electricity consumers. But there is another consideration; and it is that, in the case of most statutory gas companies, there is a powerful factor besides competition which encourages to lower prices to consumers. That factor is the sliding-scale of price and dividend, under which the lower the price to the consumer, the higher the dividend, and *vice versâ*. This is a condition that has not been brought to bear upon electricity supply—not even upon the part that is company controlled. But we see no reason whatever why, following the recommendation of Lord Cross's Committee of 1898—if there is exemption from the liability to municipal purchase in the case of electricity concerns united with gas undertakings (save by the promotion of a Purchase Bill, or by agreement)—there should not be in connection with them some similar application of the sliding-scale; the price of the lighting current being made the standard for the percentage amount of profit to be taken from the electricity business. Where, under such circumstances, would the consumers of electricity lose anything that they would gain from competition carried on by an expensively run electricity concern? We fail to see. As a matter of fact, under present electricity supply conditions, the lighting patrons are always the last to receive consideration.

On the general and main point of his article, we are therefore in agreement with Mr. Wordingham without adopting all that he has to say. But the case with which he prefaces this main submission is a more serious matter; and in it Mr. Wordingham, in a sense, wanders into the realm of prophecy, and places the lines of future development of both the gas and electricity industry, and fixes the limits of prospects. The gas industry is going to lose its lighting and power; the electricity industry is going to take over both these lines of business; and gas is going to displace coal for heating purposes. It is remarkable the power of prescience that some people possess. In one part of his article, Mr. Wordingham tells us that the electrical engineer has only a superficial acquaintance with gas engineering, gas production, and the recovery and treatment of residual products. We are afraid that, in framing the case in the first part of his article, our contributor has conclusively shown that the superficial knowledge of the electrical engineer also extends to the utilization of gas by the modern appliances at the command of the gas industry. We are as much interested in the part of the article with which we disagree, because Mr. Wordingham is the author, as the part with which we agree (though the latter is the more important); and therefore we will devote a separate article to it next week. It looks somewhat like putting the cart before the horse dealing with the conclusion prior to treating of the premisses. But we give precedence to policy and the stronger part of the article under notice, leaving the weaker part to take second place.

York Purchase, and a Piece of History.

THE York Gas-Works purchase scheme has fallen by the hands of the ratepayers. The poll that was taken resulted in a majority of 2000 against the measure. As a matter of fact, rather less than 9000 ratepayers voted, out of a possible 17,000; thus showing 8000 who were perfectly indifferent in regard to the matter. But there is the overwhelming majority against the purchase in the voting number; and, although it is declared that the issues were clouded by confused and misleading statements, and those voting were not fairly in possession of the facts, we are inclined to the belief that this is another instance of the resistance that in many places has been, and is being, offered to any extension of municipal trading. The old cry of private monopoly does not move to-day in the same manner that it did (say) forty years or so ago; ratepayers know more now than they did then that municipal monopoly of trading in the directions in which it is carried on has not been the uniform and unqualified success that was foreshadowed. Electricity supply has been a good example of heavy commitments, and of, in many places,

heavy levies upon the ratepayers to cover deficits—to say little of the enhanced costs of lighting streets and public buildings. The citizens of York have occasion to be well satisfied with the manner in which they have been, and are, served by the Gas Company—gas, ranging in price through ordinary meters from 1s. 11d. to 2s. 2d., according to the quantity of consumption, is cheap; and a good discount is allowed for power purposes. There was no case presented to show that the Corporation could do any better for the citizens than the Company have done; and a majority of the voting citizens have thought it better to let well alone—thus endorsing the view of the House of Lords in the early part of last year. Our only regret is that the way in which the Company were pursued by the Corporation in one House a few months ago, resulted in somewhat hard terms in regard to standard price being placed on them.

This is not the only Corporation measure projected for the coming session that has been overthrown by the ratepayers. Halifax has had the experience; and, while we are not fully versed in the issues affecting Halifax (the measure not relating to the gas-works undertaking), there is satisfaction derivable from the evidence of a reawakening interest in local affairs. But to return to the ancient city of York. This is not the first time that the Corporation have tried to become the possessors of the Gas Company's undertaking. The predecessors of the present members tried to gain control many years ago. One of the attempts was made in 1871. What happened then in connection with the rejection by the Gas Company of the Corporation offer gave force to the persistence with which a piece of legislation was urged through Parliament, which has since supplied an immense impetus to the promotion of, and opposition to, Bills by municipal authorities, and the facilities then obtained have been, directly, the inspiring cause of many a purchase project. In 1871, Mr. Leeman, then the member for York, introduced the Municipal Corporations Borough Funds Bill, following litigation in which the St. Helens, Sheffield, and probably other local authorities were concerned, and by which it was sought to restrain them from applying the borough funds for prosecuting gas and water-works Purchase Bills. There were, however, several amendments made in the measure by the Select Committee to whom it was referred; and as a consequence Mr. Leeman withdrew it.

Towards the end of the year came the rejection by the York Company of the Corporation offer; and it was hinted in the "JOURNAL" at the time that one result of this failure was likely to be the reintroduction of the Borough Funds Bill the following session. This proved to be true. Mr. Leeman again brought it forward as amended the previous session, and with certain other revision. The "JOURNAL" took up a strong attitude in opposition to the Bill, and assisted to raise the opposition that, though it did not secure the destruction of the Bill, resulted in certain useful modifications. It was regarded as a measure that, through the facilities it afforded, would be a strong menace to, and would inflict grievous injury upon, private trading concerns—such as gas and water companies. What was anticipated has come to pass. It has been both a mischievous and useful measure; so that in these days it is not looked upon with quite the same inimical eye and disrespect as aforetime. But the strange thing is that the real birthplace of the Borough Funds Act of 1872 was York; yet in 1913, the gas and water supplies are still in the hands of private Companies. The last act of the citizens conveys some assurance that they are not particularly anxious to see any change of ownership. Mr. Leeman, were he here to-day, would not regard this as a proper requital for his energetic efforts in 1871 and 1872. However, the Corporation Bill having now failed to secure the endorsement of the ratepayers, the agreed purchase clause in the Gas Company's Act of 1912 is nullified, and the Company are now at liberty to proceed on their prosperous way, exercising the new powers conferred upon them.

The National Gas Exhibition.

The question of the National Gas Exhibition has not been prominent lately; but the preliminary work is now being unobtrusively pressed forward. Reference was made to the subject by the Governor of the Gaslight and Coke Company (Sir Corbet Woodall) in his address to the proprietors last Friday. He informed them that this is the Jubilee Year of the Institution of Gas Engineers, and that the Institution and the Society of British Gas Industries are promoting an exhibition in celebration of the event, and to advertise the latest successes in the applications of gas, on a scale and plan not hitherto attempted. The Directors of the Company are taking an active part in working to secure its success. We hope the chairmen of other gas companies will see their way at the meetings this month to give publicity to the exhibition; and a further interesting point in their speeches would be a reference to the fact that this is the first year of the second century of statutorily authorized gas supply.

Quarter Million Sterling Scheme at Tottenham.

With nearly a 13 per cent. increase in consumption in the past six months, preceded by notable increases through a long unbroken chain of half years, the Directors and the Engineer (Mr. A. E. Broadberry) of the Tottenham and Edmonton Gas Company, have had to consider something more than the modernizing, reconstruction, and ordinary extension of the works. The result was announced at the meeting on Saturday. Irrespective of the scheme for the transfer to the Company of the extensive Enfield gas supply area, the Directors have adopted the proposals of the Engineer for the expenditure of about a quarter of a million sterling on new works adjacent to the present ones, which to-day constitute one of the most pleasing models of modern gas-works construction of which we know. The Company are financially and in respect of business development in an excellent position for carrying out the scheme. The price of gas is low (2s. 1d. per 1000 cubic feet), and business, as already mentioned, is flourishing exceedingly. The capital account per million cubic feet of gas sold is low; and the charges for capital (with a good dividend) are very moderate per 1000 cubic feet disposed of. The Company will have no difficulty in obtaining all the capital as and when they require it for the new works.

Electricity Supply by the Company.

A further interesting part of the speech of the Chairman (Sir Corbet Woodall) at last Saturday's meeting of the proprietors comprised figures resulting from the further census made of the Company's connections. For these figures, as well as the information given regarding the transfer of the Enfield gas undertaking, and the proposed entry upon the business of general electricity suppliers in the Wood Green district, readers must refer to the report of the proceedings, which will be found of peculiar interest. In the Wood Green district, the Company have already three large private installations of electricity plant which are considerable users of gas. They are not therefore without experience as to what can be done in the way of cheap electricity supply by an established gas undertaking. The local authorities are with them in this matter. To the Wood Green Council the offer of the Company is more advantageous, as it is also to the prospective consumers of current, than the scheme of the Metropolitan Electric Power Supply Company, who are likely to be the only active opponents in Parliament. Local authorities with unexercised electricity supply powers, and with flourishing gas companies in their areas, might well consider the question of the latter giving an economical supply of current. An article on "The Alliance of Gas and Electricity Supplies" appears in our editorial columns to-day.

Lewes on Liquid Fuel.

Now that Professor Vivian B. Lewes has come to the end of the course of Cantor Lectures on "Liquid Fuel," it can be said that he has done excellent service in their preparation; for the vast amount of information that he has compressed into them represents an extent of work that only one can appreciate who has attempted something on similar lines. In the subject of liquid fuel, the gas industry is largely concerned—not only on account of competition with gas, but owing to the extent to which oil is used in the production of carburetted water gas. In this latter connection, the point that will interest gas manufacturers chiefly is as to Professor Lewes's estimate regarding the future position. He does not offer any large amount of comforting assurance that the supply of natural oil is going to continue to be of such a character that low prices are likely to rule. But he qualifies what he has to say on the point by reference to the possibility of large hidden tracts of oil-bearing territory not having yet been discovered.

Oil-bearing territory is well distributed, but the different kinds of oil are not obtainable from all the sources of supply. Gas oil comes chiefly from America. But gas oil will have to take its place with the rest, and share the general effects of an increased demand, with which Professor Lewes fears fresh sources of supply will not, judging from recent developments, keep ahead. Of course, there are only present indications from which to prospect; but if the indications should develop into actual fact, then the price of oil will have a tendency to ascend and not descend. It has been seen in the past half year that erratic deliveries have had a bad effect on the consumption of oil in the gas industry. In the case of the Gaslight and Coke Company, for three months in the half year they had no oil whatever delivered, and now are flooded with it—having received practically simultaneously three ship loads.

Lighting of Factories Committee.

There was a paper read before the Royal Society of Arts last Wednesday by Mr. Leon Gaster, on the "Economic and Hygienic Value of Good Illumination." In the course of the proceedings, there were several references to the Lighting of Factories Committee which has been appointed by the Home Office, and the composition of which has been the subject of comment in the last two issues of the "JOURNAL." It is expected that great things will follow the work of the Committee; but Sir Arthur Whitelegge, who presided on Wednesday, finds that the more he looks into the matter, the further the horizon of their labour recedes. The paper and discussion had the effect of focussing a large number of the items that will claim the consideration of the Committee, if they are to make a finished job of the reference to them. One very important point was raised by Dr. W. Ettles. That is the quality of the light agents employed. It is quite clear that Dr. Ettles is not one of those who is prepared to minimize the effect in any way of the violet rays of the electric lamp. He even goes so far as to ask whether the bulbs of those lamps could not be made of a glass which would filter-out the extreme violet end of the spectrum. If this could be done, he is confident that it would increase the comfort of workers, and render "electric lamps less harmful to their eyes." Mr. Gaster also considers that the spectrum composition of light is of great consequence; but he points out that a part of the rays has a sterilizing effect. We would rather give up the sterilizing effect to obtain immunity from eye-damage. From our way of thinking there would be hardly sufficient compensation in the former for the latter. There were several allusions to the improvement of lighting in factories being an economic question, and the gains worth paying for. In many factories these gains can be achieved by a mere conversion from the ways of past-day illumination to those of the present day as offered by the gas industry, and, moreover, a direct saving be effected in the annual cost. All manufacturers are not aware of this.

Lamps Which Do Not Illuminate.

Many of the smaller towns have been led to adopt electric lighting schemes by a desire to be "up-to-date," and because it seemed the correct thing to emulate the example of the great towns. Some have had abundant reason to regret their ambition. They have found that electric lighting may be both costly and inefficient, and that its adoption has promoted neither the interests nor the comfort of the inhabitants. In cases where municipal and district councils have established electricity schemes, the discovery has frequently been made too late that performance in such cases may fall far short of expectation, and that the ratepayers have been saddled with a burden which cannot be shaken off. Far better off are the towns where the electricity undertaking is being run by a company. The council then have an opportunity of looking at things with an unprejudiced eye. If they make a bad bargain in the matter of public lighting, they know that, sooner or later, they will have the opportunity of rectifying it; while they are unconcerned by any fear of loss of business or of profit. Newquay appears to be one of the towns which have not had a very happy experience of the electric light. Judging from the report presented by the Surveyor at the meeting of the Urban District Council last week, and the discussion which took place upon it, the town has been indifferently lighted, and has suffered the annoyance of a great number of lamps failing to light-up. Everyone who is acquainted with electric lighted areas knows something of the inconvenience caused by the lamps which do not act through one cause or another; and it is little surprise to find Newquay councillors declaring that no sum of money which may be allowed by the Company for unlighted lamps can compensate for the loss of light. Newquay, in looking to its reputation as a health and holiday resort, is doing well to re-open negotiations with the Gas Company, who, no doubt, will be able to satisfy the Council that they can supply a light which may be depended upon.

Gas Making and Utilization.

There was a connection between the papers that Mr. T. Carmichael read on Saturday before the members of the Western District of the Scottish Junior Gas Association, and the one that Mr. John Ferguson contributed at the meeting of the Eastern District. The one dealt with the production of gas and its utilization for light, heat, and power; and the other supplied a number of useful points in distribution and sales work which it is necessary to observe and to practise in order to maintain and augment the popularity of gas. The greatest interest in Mr. Carmichael's paper will be found in the description of the vertical retort-settings at the Dawsholm Gas-Works, on the system developed by Mr. Alex. Wilson, and which system has taken a middle course between the continuous and the intermittent types. The system was designed and perfected by Mr. Wilson for the express purpose of dealing with the Scotch coals that are used for the production of gas at Glasgow; but we are not without hope of hearing something as to its operation away from the place of its birth, and under the working conditions as to coal and quality of gas in other parts of the country, seeing that Messrs. W. J. Jenkins and Co. are taking up its commercial exploitation. The production of the quality of gas that is required to-day, combined with the best returns per ton of coal carbonized, has been largely aided by the newer systems of carbonization, and changed practice in connection with the old; and Scotland has realized this, although at a slower rate in some places than in others. We welcome all systems of carbonizing that can contribute to the progressive work of to-day; and the competition of these systems are an advantage. Mr. Ferguson's paper is, like that of Mr. Carmichael, full of point. There seems to have been a slip in the paper of the former towards the end, where comparison is made of high-pressure lighting in a factory with a displaced flat-flame system. It is stated that the consumption of gas was reduced by 51·34 per cent., with an increase in the lighting efficiency of more than double. Under the flat-flame system, the consumption of gas in a year was 527,600 cubic feet. If we take 4 candle-hours per cubic foot of Scotch gas, this consumption would only represent 2,110,400 candle-hours. In the case of the high pressure incandescent system, a year's consumption was 270,900 cubic feet. If we allow 60 candle-hours per cubic foot, we have in the consumption quoted a total of 16,254,000 candle-hours. Mr. Ferguson was certainly far too modest in speaking of the lighting efficiency under the new conditions as showing an increase "of more than double."

Exhibitions.—It was stated in the recently published report of the British Electrical and Allied Manufacturers' Association, that arrangements were on foot for the formation of a Joint Exhibition Committee composed of representatives of the Association, of the Incorporated Municipal Electrical Association, and of the supply companies. The terms of reference to the Committee would be to consider whether, and, if so, by what means, agreement could be reached as to the Association's attitude towards proposals for holding exhibitions, and the nature of such exhibitions—having regard in particular to the question of avoiding overlapping throughout the country.

Sir Corbet Woodall to his Co-Partners.—The current number of the "Co-Partners' Magazine" of the Gaslight and Coke Company opens with the following message from the Governor: "Since His Majesty the King was pleased to indicate his intention of conferring upon me the honour of knighthood, I have received many letters, messages, and forms of resolution from employees of the Company, expressing their pleasure and offering congratulations. These communications have given me much gratification; and I desire to express to the senders my very sincere thanks. The number received has been so large that I cannot hope to be able to send acknowledgments and thanks to my friends individually; therefore I must ask them, collectively, kindly to accept this expression of my heartfelt appreciation. I take this opportunity of renewing my best wishes, already conveyed through the 'Co-Partners' Magazine' for a very Happy New Year to all."

PERSONAL.

At the "Investiture" held by the King at Buckingham Palace last Thursday, the ceremony of knighting Mr. CORBET WOODALL, D.Sc., M.Inst.C.E., was duly performed by His Majesty.

Mr. P. C. BALCON, of the Central Laboratory, Birmingham (whose paper on "Technical Gas Analysis," read before the Midland Junior Gas Association, appeared in the "JOURNAL" for Jan. 14), has been appointed Senior Chemist in charge of the laboratories and testing plant at Stockton-on-Tees of the Power Gas Corporation, and will shortly be leaving Birmingham to take up his new duties.

We are pleased to learn, from the current number of the "Journal des Usines à Gaz," that M. HENRI-OCTAVE LAURAIN, who has been the Technical Director of the Paris Gas Company since 1908 and their Consulting Engineer since 1911, has been nominated a Chevalier of the Order of the Legion of Honour. It may be remembered that, at the meeting of the Société Technique du Gaz last June, M. Laurain read an important paper [given in the "JOURNAL" at the time] on the "Estimation of Naphthalene in Gas at the Paris Gas-Works." He has seen more than twenty-two years of civil service.

At His Majesty the King's levée held at Buckingham Palace last Tuesday, the name of Second Lieut. C. V. BENNETT, of the 5th Battalion the Queen's Own (Royal West Kent Regiment) appears among those who were presented by the Inspector-General of the Home Forces. Lieut. Bennett is a son of Mr. C. V. Bennett, the Manager of the Herne Bay Gas and Coke Company, and is Assistant-Manager to the Dartford (Kent) Gas Company. On the same occasion, Second Lieut. D. E. MACPHERSON, 3rd Battalion Gordon Highlanders, was presented by his father, Lieut. Donald Macpherson, formerly of Manchester.

Mr. FRANK BATT, third son of Mr. William Batt, of Manchester, has been appointed Engineer, Manager, and Secretary of the Flint Gas and Water Company. He was educated at the Manchester School of Technology, and became an articled pupil to Messrs. R. & J. Dempster, Limited. He was two years in the drawing office, had practical experience in the various departments, and was engaged on several large constructional works. In 1907, he received an appointment in the Belfast Corporation Gas-Works, where he had upwards of five years' practical experience in all branches of gas-works routine. He holds honours certificates in "Gas Engineering."

Mr. A. W. SMITH, who was chief assistant to Mr. W. Wastell late Deputy-Secretary to the Birmingham Corporation Gas Department, was appointed Chief Clerk in the Secretary's office when Mr. Wastell left to take up his new position as Secretary to the South Suburban Gas Company; and he has now been made Assistant-Secretary to the Gas Department—the appointment to take effect as from the 1st ult. Mr. Smith, who was first under Mr. Henry Hack at Saltley, has gradually worked his way up in the Birmingham Corporation service; and those who know him best are those who feel most strongly that his success is thoroughly well deserved. Mr. A. FOLLAND has been selected for the position which Mr. Smith is relinquishing.

OBITUARY.

The funeral took place on Wednesday last of Mr. GEORGE L. DUNSFORD, who died at the age of 69. Deceased retired from the position of Chief Clerk and Cashier of the Exeter Gas Company in March, 1911, after fifty years' service; the Directors voting him a retiring allowance. The Directors and staff of the Company attended the funeral.

Mr. J. A. COOMBS, who has been for some years in the service of the Cheltenham Gas Company, in the engineering department, was taken suddenly ill last Friday night, and died before medical assistance could be obtained. Deceased was a student of various branches of natural science, and was also a Fellow of the Royal Geographical Society.

News has just reached England of the death, on the morning of the 17th ult., at the home of his daughter in Pasadena (Cal.) of Professor THADDEUS S. C. LOWE, whose name is so closely associated with the early efforts to produce water gas. He was born at Jefferson (New Hampshire) in August, 1832, and was consequently in his eighty-first year. With only an ordinary school education, and some special knowledge of chemistry, he became a prominent figure in science at the age of twenty-three. In 1860, he constructed the largest aërostat ever made, and then turned his attention to practical ballooning. He was the inventor of an ice-making machine. His great achievement, however, so far as the gas industry is concerned, was the completion, about 1875, of his plant for the production of water gas. From that time his inventive faculties were employed in effecting improvements in it; and they followed in quick succession. The Lowe process has been fully described from time to time in the "JOURNAL." It is estimated that practically all the gas used on the Pacific Coast is made by means of some of his inventions. From 1897, he had been engaged in devising and putting into operation a new coke-oven system for simultaneously producing gas and metallurgical coke.

ELECTRICITY SUPPLY MEMORANDA.

THE manufacturers of electric cooking outfits—of the biscuit tin and other forms—must have had their feelings sadly outraged by the members of the "Point Fives" Association. These are the central station engineers who supply, for cooking and heating purposes, energy at, so run the newly adopted rules, a flat-rate of 0·5d. per unit, or at a "reasonable" fixed primary charge, *plus* a secondary charge not exceeding 0·5d. per unit. The 0·5d. is necessary, and yet not effectual, in competing with gas charged at lighting rates; and the "Point Fives" blame not the 0·5d. per unit for the inappreciation of the public of electricity for baking, boiling, and the other operations comprised in the term "cooking," but the fact that cooking outfits placed on the markets by the makers do not meet requirements. That is a nasty knock after nearly all firms engaged in the production of electrical appliances have brought out their own special outfit, after expending upon it much time and money. and the best talent they could command. But it seems that the knowledge of the workers in the camps of the manufacturers does not comprise the requirements of the domestic kitchen. Therefore the work that has been done so far needs scrapping if the ripening field that the electrical enthusiasts affect to visualize is to be reaped, and something of a different order placed at the disposal of the "Point Fives" and those central station engineers who hope to get people to cook by electricity at 1d. per unit. From what was stated at the last meeting of this little body, by Mr. W. H. Cooke, of Luton, it is clear that the opinion of the members is that the 0·5d. per unit will not succeed in promoting the more rapid and extensive use of electrical energy for cooking purposes, unless electricity supply concerns are furnished with a compact, reliable, and low-priced cooking outfit, which will meet the requirements of the average family of six to eight persons. What about the "saving" in the shrinkage of "meat," and the "saving" of £25 to £100 a year on the butcher's bill of an ordinary household? That surely ought to draw. The "Point Fives" know that the public treat the matter of this hypothetical saving as it deserves to be treated. So the one thing needed is a "reliable" and "low-priced" cooker. Therefore the rating of the cooker outfit manufacturers for not knowing the needs of the public, nor realizing the potentiality of the business spread before them if the price of the apparatus brings it within the reach of the middle-class consumer. The difficulty is admitted to be a very real one. The solution that is put forward is the standardization of the apparatus. It is suggested that the Association should frame and adopt a standard specification for a cooking outfit, and that members should promise to purchase a certain number of outfits over a given period. By some it is thought that standardization would lead to the petrification of individual endeavour, and block the way to improvement. It has not been announced whether the other members of the Association agreed with Mr. Cooke as to the specification and promise; but the manufacturers will not overlook the expression of opinion.

Unsuitable Cooking Outfits.

"I Insist."

It was perfectly well known before the meeting of the "Point Fives" that the material results of the electric cooker campaign were not of such a satisfactory order as the central station engineers would like to see. As was recently stated, the "Electrician" acknowledged that, without a persistent campaign of demonstration up and down the country, the electric cooker would not make much impression on the cooking business of gas undertakings. But it was apparently the view of our contemporary that the cooking outfits on the market were all that were wanted for the purpose. Now the "Point Fives" say that this is not so. However, we see that 0·5d. per unit, demonstrations, and a reliable and cheap outfit are all necessary to progress. It is noticed in this connection that Mr. B. Horsley, the Engineer and Manager of the Harrow Electric Light and Power Company, has been writing to the papers to point out, firstly, that he has adopted a revised tariff for electricity. For domestic supplies for all purposes, he charges a fixed rate per quarter of 8d. in the pound of the rateable value of the premises, *plus* a running charge per "kelvin" (kilowatt-hour) of 1½d. in winter and 1d. in summer; or alternatively, for heating and cooking (if separately metered), a flat-rate per kelvin supplied of 1½d. in winter and 1d. in summer. That is to say, the user has to pay more per unit in winter when his lighting and heating bills are heavier than in summer when they are lighter—in order to meet the idiosyncrasies of the central station. Then, secondly, Mr. Horsley asks, in regard to auxiliary domestic apparatus, "Will manufacturers bear with me if I insist on the importance of two details?" Whether or not the manufacturers bear with him, it is pretty evident that Mr. Horsley will insist on any appliances that he buys being of a character in which (1) the heating element is easily replaceable, and at small cost; and (2) the connector or flexible cord will be able to withstand kitchen handling. In some apparatus, item No. 1 has been met, as manufacturers were soon brought to see that, unless the heating element could be renewed *in situ* without sending the whole "bag of tricks" back to the makers for renewals and repairs, the doom was sealed of domestic electric appliances. With regard to item No. 2, he says that this has not, "so far as I am aware been solved, except

at a cost comparable with the price of the main article." These last words are severely cutting, but not too much so. Mr. Horsley does not want to bring electricity into disrepute for domestic purposes by "shocking" the ladies of the kitchen, or having a death in his district through a defective wire and a wet floor. Mr. Scott Ram, in his last annual report, called attention to the dangers of flexibles connected with hand irons for laundry work. Concerning the relations of manufacturer and user, there can be a very wide application of certain words used, at the annual dinner of the British Electrical and Allied Manufacturers' Association, by Mr. Samuel Insull, the President of the Commonwealth Edison Company of Chicago. Stating that the Association was formed to look after the interests of the manufacturers, he added that, "if it was to accomplish its purpose, it must also take care of the interests of the users of electrical apparatus." There is a depth of meaning in these words that can be commended to the consideration of every producer of every commodity.

The Slogan.

Let us return to the "Point Fives" for a moment. The rules have been published of the new Association; and the second one states that the object of the Association "shall be" to encourage and develop the use of electricity for all possible domestic purposes. That is a very laudable and quite appropriate object for electrical engineers; and one can hardly imagine an electrical tariff reform association having any other object. But it is put into print in order that the members, after dining at Pagani's, may not forget the real purpose for which they are called together, or, if they do forget, may be reminded of it. The conditions as to eligibility were pointed out in the first paragraph. But the Association is to be a very close one; and compliance with the rule as to eligibility is not an assurance that the candidate will get in. Candidates who are eligible for membership are also to be balloted for at a meeting of the Association; and one blackball will exclude. The candidate runs a risk of being excluded on other grounds than the one as to eligibility. Rule 5 states that the slogan of the Association shall be: "All together, all the time, for everything electrical." The "Electrician" asks what is wrong with "Gas must go" as the slogan of the Association? There was a great deal wrong about it. The members of the Association did not want the sane part of the world to think they have already qualified for a certain establishment at Colney Hatch; it is quite enough to enter into a solemn compact to put themselves on the high road for such a place by adopting the slogan, "All together, *all the time*, for everything electrical." People without diversion in life generally develop mental trouble.

Fatal Voltages.

Adverting to shocks and the sometimes serious results, the Factories Department of the Home Office take a very serious view of the matter; and they are fortified in their view by their experience. The other day at Leigh the Howebridge Spinning Company were before the Magistrates charged with a breach of clause 13 of the electricity regulations of the Factory and Workshops Act of 1901. The circumstances were explained by Mr. J. Owner, one of H.M. Inspectors of Factories. He stated that a man named Hesketh was using a portable electric lamp when he received a shock. "There was a danger when handling the apparatus, while standing on a wet floor, of electricity passing through a man's body, and causing death. The apparatus in this case was liable to become charged with electricity at a pressure of 130 volts, *which was sufficient to cause death*." A lower voltage than that has been mentioned by experts recently as being sufficient to produce fatal results. The defendants were fined £5 and costs. The case has also been reported of William Laming, aged 32, a labourer, who met with his death by electric shock on Jan. 23 at Wandsworth, where he was employed on some sewerage work. On this work an electric-crane was used; the voltage of the energy being 200. It was evidently the hook of the crane chain that came into contact with the "great vessels of the neck." Dr. R. S. Trevor, of St. George's Hospital, expressed the opinion at the inquest that the deceased received a shock at the side of the neck, where a pink mark was found. This mark corresponded with the height of the hook of the crane; and as contact was in the region of the great vessels of the neck, it was quite sufficient to produce immediate death. The internal organs were all healthy. The jury found that Laming was killed by an electric shock; and they advised that there should be further precautions and inspection in the case of such plant. The voltages referred to here are below those admitted into private dwellings in most districts. Relating to this matter, we agree with the opening words of an article on "Electrical Dangers," by Mr. S. Lees, in the "Electrical Review." He says: "The intelligent observant mind cannot fail to have noted, with something akin to alarm, the rather disturbing frequency of fatal accidents, particularly among skilled workers, during the past twelve months or so." The sentence is redundant in terms; but the excess emphasizes the view of the writer as to the gravity of the situation.

Artifices and Evasions.

"There are two ways of competing with a rival who scruples not to take any and every advantage. One is to address criticism to him directly and forcibly, exposing his artifices and evasions; the other is for the canvasser to confine himself strictly to the superiority of his own wares over other wares in general." We adopt these words from a paragraph in the "Electrical Times." Then follows an example of the latter method. It begins: "Electricity has now become officially recognized by the Government of this country as the one and only perfect agent for lighting." We have not seen any announcement of this recognition by the Government; we know full well that the present officials in the Office of Works have lately inclined to electricity without giving even a trial to the modern forms of gas lighting. Then it is said that "the House of Commons changed over to electric lighting last year, acting upon expert medical advice." That is an absolute falsehood. The change-over was determined upon by the officers already referred to, before an ophthalmologist was consulted, and without attempting to try modern gas-lights. The advice given by the eye specialist was not that there should be a change-over, but he expressed the opinion that the rays of the metallic filament lamps would not injure the eyes of honorable members of the House, seeing that the harmful effects of those rays would be neutralized by having to pass through holophane globes and sheets of amber glass. "The improvement," it is next stated, "represents a saving in money, an increased light, and a more hygienic one." That is not all true; and it would be entirely untrue in comparison with modern gas lighting. There are also on record, from his personal statement, the expedients adopted by Mr. A. P. Trotter—a Government official, and an expert in electrical matters—to protect his eyes from the bad effects of metallic filament lamps. Then, in the paragraph in question, there is reference to the expression of view of certain inspectors as to the lighting of railway trains; but there is omission to give to one of them the title recently conferred upon him by His Majesty. Reference to these views is made for the purpose of dragging in their opinion as to electric lighting being the "safer method." But we do not see any allusion in this connection to the fires that have been generated in buildings—Government buildings included—through electrical faults; and, as bearing upon safety, there is no reference to the many deaths that have been occasioned, as emphasized in the reports of one Government Department—the Factory and Workshops Department of the Home Office—at ordinary supply voltages. Attention is also called to the patronage by the Labour Department of the Board of Trade of municipal electricity supply, as well as of company supply for the sake of uniformity. Further it is not overlooked that in those places where electricity supply is municipally controlled, there is a tendency—despite all considerations save one—to convert the lighting of the public establishments from gas to electricity. The real reason for this is carefully avoided. The writer of the paragraph before us talks of exposing "artifices and evasions." We should be interested to see what sort of a job he would make of exposing his own.

False Representation.

More complaint has appeared in the "Electrician" as to the false representations of electric lamp makers regarding the performances of their wares. Mr. Makower's experiences with metallic filaments were noted a fortnight ago. Mr. T. Mather has since had a turn in our contemporary; his experiences being with carbon filament lamps. Out of six batches of lamps he only found one batch "reasonably satisfactory" in approaching their ratings. The lamps were obtained from dealers of repute. The nature of their reputation is not specifically stated. But we see that one batch of 100-volt 32-candle power lamps gave, *on the average*, only *half* the marked candle power at the marked voltage. "On the average" indicates that some of the lamps were giving below 16-candle power; and these are represented to the public as 32-candle power lamps. Virtuous electrical industry! Those electrical critics who gird at gas-lamp makers who speak of ordinary inverted gas-lamps giving 25 candle-power (we have seen 30 candles mentioned) per cubic foot of low-pressure gas, when, on some supply systems, only 20 candles can be obtained, will note the difference between the ratings and the performance of the products of electric lamp makers "of repute." Another set of lamps when tested by Mr. Mather—200-volt 32-candle power lamps—gave 20 candles at 200 volts. Other lamps were used giving between 38·5 and 44 candles at efficiencies of from 4·3 to 5 watts per candle. Out of a further consignment of 24 lamps, only two gave as much as 32-candle power; the remaining 22 averaging 28-candle power at the marked voltage, and the average "inefficiency" was 4·7 watts per candle. Mr. Mather naturally concludes that there is little doubt the public are being defrauded by the incorrect description of lamps; and in the interests of the industry as a whole, he urges that "steps should be taken to prevent its [? the industry's] continuance."

Lamp Ambulances Required.

The metallic filament lamp is physically exceedingly sensitive. It claims the very best velvet-gloved treatment in transit between the makers' works and the place where it is expected to perform its light-giving and eye-damaging functions. A case was recently heard in the City of London Court, in which a claim was preferred for £3 10s. 2d. for lamps supplied. Defendants were evidently very dissatisfied with the performance of the lamps. It was solemnly alleged that they would only burn for a few hours, and then went out. In all 53 bad lamps were returned. The plaintiff was Mr. David Smith, trading as David Smith and Co.; and, on his behalf, a very bad character, according to the newspaper report, was given to metallic filaments as a class. It was stated that "when a metal

filament lamp was touched, the filament shortened, and then double the amount of current had to be passed through it. They might go out, or blacken at once." In this case, however, the plaintiff contended that the lamps were injured after they were delivered, and were roughly used. Judge Lumley Smith had some sympathy for his namesake, and found for him £3 and costs. But His Honour advised that metallic filament lamps should be carried in an ambulance; as, if they were conveyed in a van, the filaments got broken. The electrical papers ought, with more prominence than they have done, to call the attention of lamp makers to this recommendation of the learned Judge.

Congratulation.

Somehow or other a member of the staff of the "Electrician" has got it into his head that the writer of "Electricity Supply Memoranda" can lay claim to Scotch descent. Such an honour is not his portion. However, the member of the staff of our contemporary informs us that our recent reference to Mr. Cramb, and the unaccepted invitation extended to him, erred in one particular. He says that he has "pleasure" [that is unkind to Mr. Cramb, or to the Electricity Supply Publicity Committee] in stating that we are incorrect in saying that Mr. Cramb is Vice-Chairman of the Committee. He "has resigned his position on that body." We congratulate Mr. Cramb.

WATER BILLS FOR 1913.

[First Article.]

In preceding issues of the "Journal," the principal features of the Gas Bills and Provisional Orders for next session have been indicated. It remains to deal with the measures relating to water supply; and we take first those promoted by companies.

The Bill of the Bournemouth Gas and Water Company is to authorize the purchase of the undertakings of the Christchurch Gas Company and the Wimborne Minster Water-Works Company, Limited, an extension of the limits of supply, and the raising of further capital. The details of the Bill have been sufficiently indicated in the notice which appeared in the "Journal" for the 14th ult., p. 88. [*Parliamentary Agents: Messrs. Crowders, Vizard, Oldham, and Co.*]

Application is to be made to Parliament for sanction for the transfer of the undertaking of the Bishop's Waltham Water Company, Limited, to the South Hants Water Company. From and after the date of the transfer, the rates and charges of the latter Company for the supply of water in the parishes of Bishop's Waltham and Curdridge are to be those authorized by that Company's Acts, passed from 1876 to 1910. The Company will require power to maintain and continue the existing works and take waters; but they will not construct any works for abstracting or intercepting water from any lands acquired by them, unless they are authorized by, and the lands upon which they are to be constructed are specified in, the Act applied for or some other. Provision is made in the Bill for the application of the funds of the purchasing Company. A schedule to the Bill contains the agreement confirming the sale. It is set forth that the purchasing Company shall pay for the undertaking to be acquired the sum of £11,212 10s., the amount by which the capital expenditure of the selling Company shall exceed the issued capital on Dec. 31, 1911, and such further sum as shall represent the capital expenditure incurred from the date just named; also the value of the stores and the recoverable book debts at the date of transfer. The works comprise an engine-house and well, with pumps, a service reservoir, and a conduit or pipe-line connecting them. [*Parliamentary Agents: Messrs. Martin and Co.*]

A Bill has been promoted to incorporate the Heathfield and District Water Company, and to enable them to construct works and supply water to certain parishes, or portions thereof, in the county of Sussex; to acquire the water-works section of the undertaking of the Ticehurst and District Water and Gas Company and the undertaking of the Heathfield and District Water Company, Limited; to enter into agreements with the owners of these undertakings and with local authorities or others; and to amend the Ticehurst Water Act, 1902, and the Ticehurst and District Water and Gas Act, 1904. The limits for the supply of water are the parishes of Burwash, Etchingham, Salehurst, and Ticehurst, in the rural district of Ticehurst; the parish of Waldron, in the rural district of Uckfield; and the parishes of Heathfield and Hellingly (except a defined portion of the latter), in the rural district of Hailsham—all being within the eastern administrative division of the county of Sussex. The Company will be established for the purpose of making and maintaining the water-works specified, and for acquiring, improving, and maintaining those described in the Bill, and for carrying on the business of water supply. The capital is to be £30,000, in £5 shares; and borrowing powers to the extent of £10,000 are required, as well as authority to create debenture stock. The consideration for the transfer of the water undertaking of the Ticehurst Company is to be £9000, less such sum as they may be entitled to deduct under the conditional agreement contained in a schedule to the Bill. As from the day of transfer, the paid-up capital of the Ticehurst Company is to be reduced by two-fifths; and the provisions of the Act of 1904 are to be deemed to be amended accordingly. The Company require authority to maintain the existing works, and, as already stated, to construct others. The latter consist of a well in the parish of Ticehurst, adjoining the existing well and pumping-station of the Ticehurst Company, and five years are required for its completion. The proposed rates at which water will be supplied for domestic purposes are the usual 8s. 8d. per annum where the rateable value of the premises does not exceed £5, and from 10 down to 7 per cent. per annum for rateable values up to but not exceeding £80 per annum. Above this, the rate will be 6 per cent. The Company do not undertake to supply water for domestic purposes to any house for less than 8s. 8d. per annum; and they will make the usual extra charges for closets and private baths. Where the supply is by meter, the price is not to exceed 1s. 6d. per 1000 gallons. Provision is made in the Bill for the Company to enter into contracts for the supply of water in bulk. [*Parliamentary Agents: Messrs. Mills and Morley.*]

The Mid Kent and East Kent District Water Bill is a rather comprehensive measure for extending the limits of supply of the Mid Kent Water Company, sanctioning and confirming the construction of the existing works, authorizing the carrying-out of new works, and conferring further powers upon that Company and the East Kent District Water Company, both of whom are desirous of entering into agreements with each other and with the South Kent Water Company. The works for which confirmation is required are three pumping-stations, six service reservoirs, and a number of conduits or pipe-lines; and the new works comprise three pumping-stations, in the parishes of Burham, Charing, and Barham respectively, four service reservoirs, and several conduits or pipe-lines, wells, adits, &c., all of which are to form part of the undertaking of the Mid Kent Company, whose limits of supply are to be extended so as to include a number of places in the rural districts of Elham, East Ashford, Faversham, Hollingbourne, and Bridge, in the county of Kent. So much of the Canterbury Gas and Water Company's Act of 1866 as relates to Chartham and Upper Hardres, in the rural district of Bridge, is to be repealed. The period required for the construction of the new works is seven years from the passing of the Bill. The Company wish to be empowered to sell water by measure and in bulk. In addition to their existing authorized capital, the Mid Kent Company require authority to raise a sum not exceeding £80,000, and the East Kent Company anything up to £45,000, to be limited to 7 per cent. dividend if raised as ordinary, or to 6 per cent. if raised as preference capital, with borrowing powers in each case to the extent of one-fourth. They wish for permission to create debenture stock. Authority is sought for the sale to the Mid Kent Company by the Hollingbourne Rural District Council, subject to the consent of the Local Government Board, of the water-works undertaking of the Council situate in the parish of Ulcomb, in the county of Kent, on such terms, and subject to such conditions, as may be agreed upon, and be approved by the Board. Provision is made in the Bill for the appointment of a Managing-Director, for fixing the remuneration of the Secretary, and for the erection or acquisition of cottages for employees. The East Kent Company require authority to enter into agreements with the Dover Corporation in respect of the reduction of the rates charged for water by the Company in the part of the borough which is included within their statutory limits, so that they may correspond with those of the Corporation. [*Parliamentary Agents: Messrs. Lewin, Gregory, and Anderson.*]

The South Staffordshire Water Company are seeking power to construct additional works and raise more capital. The works comprise a pumping-station in the parishes of Sutton Coldfield and Weeford, another in the first-named parish, a service reservoir in the parish of Oldbury, and three connecting pipe-lines. Seven years are required for their completion. As the result of the extension of the boundaries of Birmingham under an Order obtained in 1909, the parish of Quinton, in which the Company has powers of supply, has been included within the water area of the Corporation. An agreement has accordingly been entered into between the two bodies for the transfer of the mains, &c., to the Corporation; and confirmation is sought for it. The Company require authority to raise additional capital not exceeding £100,000, including premiums, to be limited to 7 or 5 per cent., according as it is raised as ordinary or preference, with borrowing powers to the extent of one-third, and permission to create debentures. [*Parliamentary Agents: Messrs. Sherwood and Co.*]

A short Bill has been promoted by the West Hampshire Water Company to confirm and make valid the creation and issue of shares and debenture stock by the Company. There are only seven clauses. The first contains the short title; the next two ratify the creation and issue of the ordinary and preference shares; the fourth specifies that the debenture stock is to be deemed to have been created and issued under the Company's Acts of 1893 and 1902; the fifth sanctions the borrowing of money in respect of the unissued capital authorized by the first-named Act; the sixth sets forth that nothing in the Act is to diminish or affect the power of the Company to borrow conferred by the 1902 Act; the final clause provides for defraying the costs of obtaining the Act. [*Parliamentary Agents: Messrs. W. & W. M. Bell.*]

The Vertical Gas-Retort Syndicate, Limited, have advice from the Dessau Company to the effect that an order has been received for Dessau verticals from the Groningen (Holland) Gas-Works for five beds of eighteen 4-metre retorts—making ninety retorts in all.

OUR FRIEND THE ENEMY.

By C. H. Wordingham, M.Inst.C.E.

This article was written and forwarded for publication in the "Journal" entirely on the author's own initiative; and as it is interesting to have views from both sides, and the reasoning that leads up to those views, on matters of policy affecting the gas industry, we publish the article precisely as submitted. The question of policy receives editorial comment in an earlier part of this issue, and, as will be remarked, it is intended to discuss the first part of our correspondent's contribution next week.—Ed. J.G.L.

Gas and electrical energy, supplied to the public from networks of mains, have long been in competition for lighting, heating, and motive power. Those responsible for the respective undertakings have pushed them to the utmost of their ability, and each has extolled the merits of his own supply and belittled those of his rival's. It is right, fair, and proper that the best should be made of the case for the commodity which a man has to sell, and even a little exaggeration may be forgiven; but no permanent measure of success can ever attend pushing a business unless real merit lies behind the claims made. To put forward an agent for purposes for which it is ill-suited may meet with apparent success in the first instance; but in the long run, only damage can result to the object in view.

Lighting.

Electrical engineers are bound to admit, and do admit, the extraordinary progress that has been made in gas lighting; and perhaps they derive a certain amount of bitter satisfaction from feeling that if it had not been for them this great advance would never have been made. On the other hand, every gas engineer knows in his innermost heart—though he naturally would not care to admit it—that the most modern of burners, maintained with the best expert knowledge, rapidly drop in candle power by a heavy percentage, so that the test figures for gas consumption per candle are soon largely exceeded; while without such expert maintenance the burners are a perpetual nuisance for want of regulation, deterioration of mantles, &c. Again, however solemnly arguments in favour of gas on account of its wholesomeness when burnt for illumination and its disinfectant properties may be put forward, it may well be doubted whether one gas engineer in a hundred makes these statements with any real belief in them. Such arguments are a sign of a weak case, and no good can come of shutting one's eyes to the truth.

What are the actual facts? The invention of the tungsten filament lamp has profoundly altered the lighting situation. These lamps will give one British candle for the expenditure of 1·2 watts, and they will maintain their candle power for a long period. Quite easily, at this efficiency, they will not drop more than 20 per cent. at the end of 1000 hours, and, unlike incandescent gas-burners, they require absolutely no attention whatever during this time. The life of the lamps is vastly greater than that of carbon filament lamps—indeed, the chief trouble of the makers is that they last so long as they do!

Let us see what this efficiency attained by electric lamps means. Gas engineers will probably not be dissatisfied if it be assumed that a light of one candle can be maintained for one hour by 0·083 cubic foot of gas. The corresponding expenditure of electrical energy is 1·2 watt-hours, whence it follows that one Board of Trade unit (1000 watt-hours) is the equivalent of 70 cubic feet of gas. On this basis, gas at 3s. 6d. per 1000 cubic feet corresponds to electrical energy at 3d. per B.T.U. These figures are deliberately chosen as being favourable to gas. It is certain that the ordinary consumer does not get the efficiency assumed for the gas-burners, and it is equally certain that the efficiency of the electric lamps is that ordinarily realized. Again, the quantity of gas burnt for a given number of candle-hours of lighting actually required is far greater than the quantity of electrical energy for the same number of candle-hours required, on account of what may be called the "switch habit." Electrical consumers very soon acquire the habit of switching-on the light only when wanted; whereas the average gas consumer lights up his gas at a particular hour in certain parts of the house, whether he is going to be there or not, and thus wastefully increases his gas bill. Taking all things into consideration, electric light in most districts is now, light for light, as cheap as gas.

The attitude of the general public towards the two illuminants admits of no question. In every case the determining factor is cost; no arguments based on the health-giving effects of the combustion of gas or its alleged disinfecting qualities weigh for a moment. The first cost of wiring will often prevent the adoption of electric light; and in some cases unduly high charges for electrical energy, or unusually low cost of gas, may turn the scale. As a general proposition, however, the bulk of the public, if they do not have to pay more for electric light, prefer it to gas on the grounds that it does not vitiate the air, does not damage paint, paper, and ceilings, requires no attention, is convenient, can be adapted to decorative effects, and, when properly arranged, gives soft and agreeable illumination without glare. After all, the public taste is the determining factor in the matter, whether it be correctly or incorrectly formed.

Heating.

So much for lighting. Let us now turn to a field of competition in which the boot is most certainly on the other leg—viz., heating. Electric heating is undeniably making progress. A radiator with carbon lamps or glowing wire spirals is a cheerful object. It looks warm; and, if you sit in front of it, feels warm. It will, moreover, raise the temperature of a room to quite an appreciable extent in a reasonable time, and, giving off no products of combustion, healthful or otherwise, it does not require to be connected to the chimney, and thus the natural ventilation of the room is not blocked, as happens when a gas-fire is so connected and is unlit. The advantages of cleanliness and convenience are sufficient to secure a certain field for electric radiators for rooms used occasionally or intermittently, or for a few hours a day—at the change of season, at the beginning or end of winter. But for genuine all-day heating of any except quite small rooms, the gas-stove easily beats it on the score of efficient and rapid heating; while the cost of heating is overwhelmingly in favour of gas on the basis of any charges ordinarily made for gas and electrical energy.

This is no question of efficiency of radiator or any temporary disability likely to pass away in time or in consequence of further invention. An electric radiator of almost any kind must be an efficient converter of electrical energy into heat, for there is nothing else but heat for the energy to appear as; hence there is practically no room for improvement. The expensiveness is inherent in the method. Instead of utilizing direct the heat energy of the fuel by burning the fuel where the heat is wanted, the heat energy is used to raise steam, the steam to produce mechanical motion, and the motion to produce electrical energy; this energy being transmitted to a distance and finally reconverted into heat. At every step there is waste—in some, very great waste; and every conversion requires heavy capital expenditure. So, unless some means of utilizing natural sources of energy other than that stored in fuel is discovered, which can only be utilized electrically, gas heating must hold its own; and the tendency will certainly be for it to spread. When one considers the immense field for gas consumption that exists in the domestic hearth, one need have no qualms as to the future of the gas industry.

Cooking.

For cooking, the case is somewhat different. Electric cooking is pre-eminently cleanly, and is far more economical of heat than gas, since the heat can be localized almost exactly where it is wanted; so that there is practically no waste, there is complete absence of fumes, and it is most convenient. Electric cooking may be expected to grow, but the costliness of the apparatus compared with that required for gas will necessarily hinder it. Although eventually it may prove a dangerous rival, that time is a good way off.

Water Boiling.

When we come to boiling water in anything except tiny quantities, the essential costliness of electrical heating, the reasons for which have already been given for radiators, is felt in the fullest degree. There is no blinking the fact that for boiling water in large quantities electrical means cannot compare with gas on the score of cost; and the superiority of the latter must remain in the absence of any revolutionary change in our source of electrical energy.

Motive Power.

There only remains motive power to consider; and here the difference between the two agents is not nearly so marked. An electric motor has certain inherent advantages which are greatly in its favour. It has a purely rotatory motion with uniform angular velocity; it governs well with varying loads; it is compact, causes no nuisance, requires no accessories, such as cooling water, exhaust silencers, &c.; and it is extraordinarily convenient and adaptable. As in the case of lighting, cost is the determining factor; and there can be little, if any, doubt that electric motors will in all cases be preferred to gas engines, and will eventually displace them entirely in the case of consumers having access to a cheap supply of electrical energy.

The Field for Gas and Electricity.

Every effort has been made in the foregoing to state the case

fairly for the rival agents. If the statements made are in accordance with fact, as they assuredly are, is it any use for either side to shut its eyes to them? No amount of special pleading will stave off the early advent of the general use of electric light; no amount of meteoric advertisement or vague or rash statement will gain the field of heating dwellings or boiling water for electrical undertakings; nothing will prevent the extension of electric motive power and the driving out of gas-engines from private consumers' premises.

Many far-seeing gas engineers and managers are beginning to perceive these facts, and a few are already taking the course which they indicate. The writer has for many years past been impressed strongly with the advantages to be gained by both sides from a better understanding between the gas and electric interests; and he has publicly advocated it. Recently he has had occasion to advise a gas company as to the establishment of an electric supply by them; and the careful consideration of an actual case has served to emphasize greatly the advantages of the course. The time seems to have arrived when the matter should receive serious consideration by the parties interested.

Some ten or twelve years ago, it seemed as though gas-engine driving were going to revolutionize electric central station methods. But the introduction of the steam-turbine, if it has not completely stopped this in large stations, has, at all events, deferred it for many years; while a contributing factor has been the cost and difficulty of constructing large gas-engines such as are necessary for the generators used. The fact none the less remains that internal combustion engines are the most economical prime-movers available, and in stations of moderate size they can hardly fail eventually to be utilized.

If gas-engines are to be used in electric stations, it is imperative that the gas should be manufactured in the most economical way possible; and without belittling the attainments of electrical engineers (who it may safely be asserted are second to none in their engineering knowledge and skill), it must be admitted that their acquaintance with gas production is in most cases entirely superficial. Now, the greatest risk of loss occurs between the coal-bunker and the engine shaft; and who can be so well suited to look after this part of the work as the gas engineer, who has devoted the whole of his time to securing efficient carbonization and the economical recovery of waste products?

Gas Undertakings as Electricity Suppliers.

In a large town, probably the best arrangement would be for the gas company to supply the gas to a distinct electrical company. But there are only a few large towns in this country which are not already supplied with electrical energy; so we may with advantage concentrate our attention on the small ones, and even villages. Here it would seem that the advantages of the gas company undertaking the electric supply are overwhelming. The benefits accruing from this arrangement may be briefly set forth as follows:—

I.—The character of much of the work and the nature of many of the problems involved are very similar, and in some cases identical, for a gas and an electrical undertaking; while the experience and knowledge of the requirements of the district and of the habits of the population gained by the older gas undertaking cannot fail, if applied to the electrical concern, to go far to ensure success where a separate management not possessing this knowledge might fail.

II.—The establishment charges—always relatively heavy in a concern of moderate size—are greatly reduced. For example, the cost of management and of clerical, collecting, and meter-reading staff would not be appreciably increased by the tacking-on of the electrical to the gas supply. Separation would practically mean duplication of these expenses; and this alone might well make the difference between a profit and a loss. In a large undertaking, of course, this would not hold to anything like the same extent, since the addition of the electrical department to the gas would necessitate an increase in the gas staff, and the charges might as well be paid direct.

III.—The advantage of the expert manufacture of the gas has already been referred to. Apart from the higher skill applied, the quantity of gas made in the combined works is much greater than would be required for the electric station alone. Hence there is the added gain of working on a larger scale, and the possibility of affording to purchase plant making for economy in production, the capital expenditure on which would not be justified in the small works.

It may be objected that for a gas company to start an electrical supply in a town in which none exists, is analogous to cutting its own throat. But this assumes that no one else will start one, and that what is gained by the electrical department is lost by the gas. From what has been said in the earlier part of this article, there can be little doubt that electric light will spread, and that if gas companies do not take time by the forelock they will be met by competition in many towns in which they are now free from it. It may further be said that if they do the work themselves, they will only put into one pocket what has come out of the other. But if they are to lose part of their custom, it is surely better to put it into another pocket of their own coat than into that of someone else. The assumption, however, that all the electric gain represents a gas loss is contrary to all experience. The gas consumption in towns in which an electric supply has been started continues to increase in spite of it. It may be said, and with some truth, that this is temporary only, and that if electric light is to grow until it supersedes gas, the gas supply must diminish. If so, there could be no stronger argument for the combination here advocated; for the electric light will merely be transformed gas, and the lost lighting demand will be compensated for by the gas used in the electric light engines. The output of the combined station will, however, increase beyond that of the gas station alone, because each of the agents will win from outside the family. The electrical energy supply will win from the steam-engine in motive power, the gas will win from coal in gas-fires for private consumers, and the higher standard of lighting set by the electric light will greatly augment the demand for light.

One more point must be considered. How will the public fare? It may be objected that the placing of the two services in the hands of one authority would create a monopoly and prevent competition. But against this is to be put the important fact just demonstrated—viz., that the gas company can generate electrical energy much more cheaply than an independent electrical authority, in consequence of the very fact of the fusion of the two enterprises. There is no escaping the fact that increased costs of production must fall on the consumer; and the public thus stands to benefit largely by the gas and electical undertakings being in the hands of one authority. This is a real and tangible advantage and one that should far outweigh any hypothetical objections to monopoly as such. In point of fact, gas and electrical undertakings are necessarily each a monopoly; and the merging of the two into one monopoly is fraught with advantages, as I have shown. Moreover, if gas in the future is to be used by the public chiefly for heating and electrical energy for lighting and power, the two would not be on a directly competitive basis.

The foregoing observations are based upon one vital assumption which, if not realized, negatives the whole of the conclusions drawn—the gas company must honestly and genuinely take up the electric supply and push it as keenly as gas. The time has gone by for trying to stifle the electric industry; and any gas company adopting the tactics that were freely imputed in the early days to those companies who sought electric powers would soon find itself in trouble, and it would moreover lose the benefits described.

Both the gas and electric industry stand to gain by the course advocated. The advantages to gas have been fully set forth; the electric industry would benefit by the advent of a large demand for plant of a moderate and profitable size, and many openings for employment would arise. The time has surely come for both parties to sink all jealousies and to join hands in an endeavour to improve their own business and give the public what it wants at the lowest price that engineering skill and sound commercial management can secure.

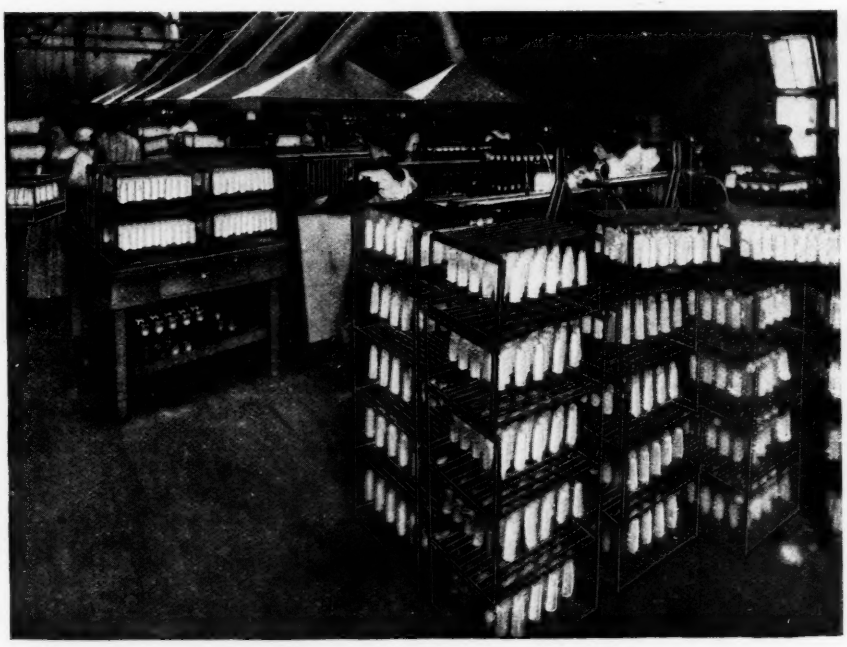
Gas-Engines and the Future of Motive Power.—At a lecture on "The Diesel Engine" by Mr. Atholl Blair, Assistant Engineering Manager at Messrs. Harland and Wolff's, under the auspices of the Belfast Association of Engineers, the President of the Association, Mr. Thomas A. Gibson, said that they were evidently on the eve of a revolution in prime-mover development, in which there were indications that the gas-engine of British design would occupy a very prominent position, with a measure of thermal efficiency closely approaching that of the Diesel engine. The race for supremacy had only just begun. The reciprocating type of steam-engine, having served them well, was challenged by the turbine. Internal combustion engines, both of the liquid and gaseous types, had, beyond all question, proved their superior thermal efficiencies; and what was more important than the burning of the fuel at the seat of its work? Mr. Stanley Johnstone, discussing the lecture, said he understood that at the Belfast Gas-Works they produced annually something like 2000 tons of gas tar oil, which was sold at 31s. per ton. He thought it was possible to use it in the Diesel engine so that they would get about 9,000,000 horse-power-hours.

Thermal Efficiency of Gas and Electricity.—In one of the "Notes" in "Nature" for the 16th ult., there was a reference to the progress of electric cooking; and the writer made the following remarks: "The present year should see a reasonably cheap and economical electric oven put on the market to compete with the every-day gas-cooker, which at present, on account of its low initial cost, still holds the field against the electric oven among the general public." The issue of our contemporary a fortnight later contained the following reply by Mr. W. M. Mason, the Secretary of the British Commercial Gas Association: "Please allow me to point out that it is not merely a question of comparative cost and upkeep of apparatus, but the more important point of comparative efficiency. The heat equivalent of one unit of electricity (costing at least 1d) equals 3410 B.Th.U., while the heat equivalent of 33 cubic feet of gas (costing in London 1d.) equals 16,500 B.Th.U. No science can obtain from a given quantity of energy or fuel more than the maximum amount of heat it produces when completely consumed; and it is therefore apparent that electricity, so far as heat production is concerned, can never economically compare with gas."

VISIT OF THE LONDON AND SOUTHERN JUNIOR GAS ASSOCIATION TO THE "VERITAS" MANTLE-WORKS, EARLSFIELD.

On Thursday afternoon, a large muster of members of the above Association (about eighty) assembled at Messrs. Falk, Stadelmann, and Co.'s "Veritas" Mantle-Works, at Earlsfield, for the purpose of an inspection. The members were received at the entrance by the following representatives of the firm: Mr. M. Falk, Mr. Bernard Young (Works Manager), Mr. Otto Young (Assistant-Manager), Mr. W. E. Bull, Mr. A. P. Kelsey, Mr. H. Salter, Mr. E. S. Baynham, Dr. F. Hiller (Works Chemist), and Mr. A. L. Austin (Secretary). The members were conducted over the works in small parties by the gentlemen named.

The works already cover a large area; and more land has lately been bought, which gives a total area of some 3½ acres. Another building and extension of the present ones will provide the further accommodation which is greatly needed—big though the existing premises are. There are now about 550 employees engaged in the works, and at the busiest season the number is still greater. Immediately the members began the tour of inspection they found themselves in a hive of industry, in which every girl appeared to be performing her task with praiseworthy dexterity. The factory was in full work, and all departments were open for inspection. First of all, the stockingette was seen in rolls, some of it already impregnated. The process of cutting into equal lengths, according to the size of mantle that is to be made, was shown, and then the fitting of the tulle band round the top of the stocking for upright mantles. Naturally, much interest was taken in the impregnating process. One of the machines being used in this operation is of aluminium; this material being a very desirable one to use, on account of its non-liability to corrode. The stockings are soaked for five or ten minutes in the lighting fluid, and then passed between rollers to remove the surplus fluid, after which they are taken to the drying-room, where they are fitted on to models. Some of these models are made of glass, but very many of them are of a substance which is found to answer equally well, and to possess at the same time the advantage of being more durable—namely, *papier maché*. The models with the stockings on them are next placed on racks, and left for about three-quarters of an hour in this room, the temperature of which is usually between 35° and 40° C. At one end of the room attention was drawn to an arrangement (which will be extended later on) by means of which the stockings are moved on a conveyor through an oven heated to about 50° C. The drying in this case takes only some twelve or thirteen minutes. For inverted mantles, the impregnating may be carried out with the material in long lengths, which are then suspended from glass rods and dried very slowly, so as to preserve an even surface. Next the heads of the mantles are hardened, colouring matter being used to show that the process has been duly carried out. Various colours are employed, so as to serve the additional purpose of distinguishing one quality of mantle from another. The mantles after this are dried again



BURNING-OFF THE MANTLES.

in another oven. In the sewing department, there were to be seen ingenious machines, of a character highly attractive to those of a mechanical turn of mind. Here the asbestos thread is run through the head of the mantle, looped, and cut, and the head shaped—on different machines, it is true, but almost too rapidly to permit one to see how it is done. These remarks refer particularly to upright knitted mantles, although the inverted patterns are treated by somewhat similar machines; but instead of the asbestos, the material of which the mantle is made is used, in a thicker form. For the tying of the mantle on the ring, however, asbestos is employed. Woven mantles have to be sewn and tied by hand.

By this time, the mantles (on which the necessary name has been stamped) are ready for what is termed the "seasoning" process; and on the way to the room where this is carried out, one passes, it may be remarked, through a neat little repair shop. The mantles are shaped on wooden models, removed and suspended in rows from bars, and then taken to the burning-off machines. All the work involved in mantle making requires care; but it is in the stage now alluded to that the greatest exercise of skill is called for. The shaping and seasoning must be intelligently done, or an unsatisfactory mantle is the inevitable result. In spite of the large amount of radiant heat given out by the machines, this is a department in which there is a good deal to induce one to linger. At the moment, a new machine is being experimented with, in which the mantles continuously revolve while suspended over the gas-flames; and subsequently the tops are separately treated by means of other burners fitted above. Thus the whole series of operations is performed on one machine. The revolving action results in the process being carried out equally all round; and the mantle can at the same time be examined. The radiant heat met with in this room has been mentioned; and, of course, this is inseparable from work of the nature of that carried on there. But it is due to the firm to state that they have made the department a model one of its kind, and studied the welfare of the employees in every possible way. Plentiful supplies of fresh air are pumped into the room through gratings in the floor; and, in fact, there is a complete change of air in the place every five minutes. The hot air from the furnaces is drawn away through the flues by means of an air-blast. Machines of different pattern are, of course, used for burning-off and hardening the inverted mantles.

After they have thoroughly cooled down, the mantles are dipped into the collodion mixture, then drained, and placed for half-an-hour in an oven heated by steam. In connection with this portion of the process, there is on the works quite an extensive plant, separately housed. Into a lead pan containing sulphuric acid methylated spirit is run, and the spirit is converted into ether, which is afterwards condensed, and passes into a raw ether tank, from which it is pumped into an overhead washer, washed, and taken to the rectifier. Here it is rectified to the specially high standard required for the mantles, and then passed to the ether storage shed, in which there are two tanks each of a capacity of 25 tons. All this plant is, of course, closed in. Other sheds contain guncotton; and eventually all the necessary ingredients are conveyed to still another building, there mixed, and passed to a storage tank.

All that is done at the factory in the way of manufacturing the mantles has now been noticed; but there is another branch of work which must not be overlooked. Careful packing is required,

A VIEW IN THE DIPPING-ROOM.

more especially for the inverted kinds; and the machinery utilized for this purpose is of a very elaborate and engrossing character. The mantles are carefully sorted and divided into "firsts" and "seconds;" and the upright patterns are trimmed on a cutting machine. The girls become so experienced that they can perceive the slightest differences in the mantles; but gauges are provided on which any doubtful ones can be tested. They are then placed in boxes, all of which are made on the premises by the machinery alluded to. Boxes of all sorts and sizes are required for the many different mantles made by the firm; and they are forthcoming, in a manner which is really wonderful to behold. Printing, too, is needed. Well, this also is done on the premises. Type is set, stereos cast, and labels produced to meet any customer's wants. In the packing-room the mantles are checked; and finally they pass to the despatch-room.

Provision against fire is seen in a very complete system of sprinklers fitted with thermostats; and a necessary adjunct to the factory is the up-to-date laboratory, in which materials are tested. A photometer-room and mantle-testing arrangements also form part of the equipment; and there is ample storage room in the basement.

After the inspection, the members were entertained at tea, following which

The PRESIDENT (Mr. D. J. Winslow), in a few remarks, said that the visit that day had been to the members one of great interest, watching the turning-out of mantles at the rate of 80,000 per day; and they had seen the whole process complete. They had been particularly struck by the enterprise shown by the firm—especially with respect to the ether plant they had erected. The firm seemed to cater for the whole of their requirements; and they had an idea of the rapid advance that incandescent lighting was making. They were also struck with the up-to-date advertising branch of the firm. Their illustrated posters were well known everywhere. This visit must be of special interest to those members who had to deal in any way in an advisory manner with the consumers. Another point that appealed to him was the colour question, which he had studied somewhat. There were special characteristics in the mineral salts that affected the tint of the mantles; and he wondered if everything had been tried that could be. But he had been informed that afternoon that those responsible had studied every well-known mineral salt in this connection.

Mr. S. A. CARPENTER (the Senior Vice-President) proposed a hearty vote of thanks to the firm for their kindness in according to the Association the privilege of seeing their works. The trade-mark of the firm "Veritas" implied "Truth," "Honesty," and "Straightforward dealing;" and that afternoon the firm had not concealed anything from their visitors, but had thrown the whole of the processes open to their inspection. It was thought years ago that the "Wenham" and other regenerative lamps were the last word in lighting; but the wonderful discovery of Welsbach had changed all this. They were very much struck by the small percentage of faulty mantles. He particularly mentioned the names of Mr. M. Falk and Mr. B. Young in connection with the vote.

Mr. E. SCEARS (the Hon. Secretary), seconding the resolution, said he did not know that anything that he might say would emphasize what had already been said. It had been quite an experience and an education to most of the members.

Mr. W. J. LIBERTY (Past-President), being called upon to support the vote of thanks, desired to include all those gentlemen who had so freely given up their time to personally conduct the visitors and explain to them all the ramifications of this interesting works. The romantic story of Dr. Auer von Welsbach's discovery in the early Eighties had been materialized here to-day before their very eyes—taking them back to that world-renowned and most celebrated laboratory at Heidelberg where Henry Roscoe, then an assistant to Bunsen (but later known as Sir Henry Roscoe, one of the leading expert chemists in this country), pointed out to his chief that a non-luminous flame could be obtained by passing coal gas a short distance through air and then taking it through a piece of wire gauze, known afterwards to the world as the bunsen flame. To-day they had been able to see the marvellous value of this simple discovery at the Heidelberg University—the birthplace of both the bunsen flame and the incandescent mantle. Baron von Welsbach could have had no conception when he discovered the light-giving properties of the salts of the rare earths to what dimensions and changes it would lead, and its great effect upon the gas industry. He (the speaker) was pleased to be present that day, because they had been over a self-contained factory. With perhaps one exception—viz., the knitting and weaving of the stockings—the whole operations were carried out under one roof including box-making, printing, &c.; and, better still, they had seen 550 British subjects at work on these mantles, and had been authoritatively informed that the mantles could be turned out cheaper than in Germany—the home of the mantle industry.

The resolution having been unanimously carried,

Mr. FALK replied, and said that he greatly appreciated the kindly remarks that had been made that afternoon; and, speaking on behalf of his fellow-Directors and the staff, he assured them they were only too pleased to receive the Association. As to English and foreign competition, he was pleased that they appreciated their endeavours to establish a mantle-factory in this country. There was not the slightest doubt the gas and the mantle industries were indissolubly bound-up together, and that the gas industry would continue to play a very important part. The gas companies were destined to do more for the community than the average person imagined. The companies gave the public not only light, but fuel and motive power. In conclusion, he would say that the origin of the Welsbach mantle was not an invention, but a discovery. He felt it right to say they owed to Mr. Bernard Young, their Works Manager and Director, a very large amount of the success of the afternoon's visit.

Mr. AUSTIN also replied, saying that in three weeks' time they would be commencing building operations which would double their premises and capacity. They did not intend to stop. They had taken up box-making, printing, and the manufacture of ether; and it was no flattery to say they were "self-contained." Three years ago they had 250 employees; to-day they had 600; and in three years' time they would likely have 800. They would then again heartily welcome the Association.

The Dessau Vertical Retort Patents.

From the "Journal für Gasbeleuchtung" of the 8th inst. we learn that the Supreme Court of Germany has not yet issued the text of the decision by which it upheld the full validity of the Dessau Company's vertical retort patents, to which several references have appeared recently in our columns. The same journal publishes a communication by the Dessau Company in answer to that of the Pintsch Company, which appeared in the "JOURNAL" for Jan. 21. The following is a translation of this new communication: "Perhaps as far as the firm of Pintsch is concerned, the matter ends satisfactorily with this new decision. But it is quite another case with gas-works which wish to make gas in the ordinary way with vertical retorts and derive the full benefits of the system—complete utilization of the capacity of the retorts, and production of thin tar and gas poor in naphthalene. Those wishing to work with Pintsch retorts cannot make use of these advantages, since at least half a metre of the heated part of the retort must remain empty, and this empty space must be heated to at least 700° C.—a temperature at which the formation of naphthalene and thick tar is inevitable. Therefore they must pay minute attention to these details of filling and heating their retorts, unless they wish to come into collision with Patent No. 167,367."

GAS WORKERS AND TRADE UNIONISM.

[From a Local Correspondent.]

Of the extent to which attempts are being made just now to exploit the trade unionist fetish in the supposed interest of the gas worker, some very significant evidence is forthcoming from Nottingham; the matter presenting considerations of more than local interest. Elsewhere there has been plentiful activity in a similar direction; but the case of the metropolis of lacemaking is peculiar, in that it has received more than an ordinary share of the attention of Mr. Will Thorne, M.P., the General Secretary of the Gas Workers' Union. The reason is, perhaps, not far to seek. Mr. Arthur Hayday, who has on more than one occasion stood unsuccessfully as a Socialist for Nottingham municipal honours, was formerly actively associated with Mr. Thorne in work in West Ham; and occupying at present the position of Secretary of the Nottingham branch, Mr. Hayday is favoured by many visits from his former colleague.

Matters have reached a pitch now which seems to indicate the faith of the coalition in its ability to make the Gas Committee "toe the line." There is to be no alternative. The members of the local branch were made to declare in a resolution, passed a few days ago at what was described as an "aggregate" meeting, addressed by Messrs. Thorne and Hayday, that the time has arrived when urgent action has become necessary to compel all non-union members to join the union at an early date; and it was added, to quote the precise language of the resolution: "We ask the General Council to give the district power to take what action is necessary." The covert threat hereby involved is obvious; but whether in the management of Nottingham's chief municipal trading concern, the Gas Committee will capitulate to trade union dictation, is a problem whose solution will be watched beyond the Midland city.

Though there has been a large amount of beating of the drum here as elsewhere, there is no inherent evidence that Nottingham is prepared to stand any further losses from outside influences. It is, of all large manufacturing centres, the one which has the least cause to be enamoured of so-called efforts on behalf of the workers. The lace trade, the city's former main industry, has for years been on the wane; its early decadence dating from the period when trade union wire-pullers first became aggressive. Since then, means of production have gone elsewhere, never to return; and though at first sight there appears to be no connection between the lace trade and gas manufacturing, the general principle of interference is again raised; and those who have most at stake in Nottingham are not likely to forget the irreparable mischief trade union tactics have entailed. This being so, it is scarcely likely that the interests of so large a concern as the gas undertaking will be allowed to be interfered with, in however apparently small degree. There is no suggestion that any reasonable representations upon the part of the gas employees, either as to rates of remuneration or hours of labour, have not been fairly dealt with. Some men do not desire to be dragooned into the union, and be made willy-nilly contributors to the funds, which go largely to keep official agitators afloat; and, if hostilities are proclaimed in this case, protection is not likely to be lacking upon the part of the Committee for non-unionists, who probably can do quite as good work as some of another class.

COMMERCIAL GAS COMPANY.

The following is the report, for the six months ended Dec. 31, of the Directors of the Commercial Gas Company.

The revenue account shows a net profit for the half year of £78,617 4s. 3d., which, added to the balance of £69,731 12s. 9d. brought forward from the previous half year, produces a net revenue balance of £148,348 17s. Deducting £7670 15s. 5d. for interest, there remains standing to the credit of the net revenue account a balance of £140,678 1s. 7d. available for dividend. The Directors recommend the payment of dividends at the rates of £5 9s. 4d. per cent. per annum on the 4 per cent. stock of the Company, and of £5 6s. 8d. per cent. per annum upon the 3½ per cent. stock, both less income-tax. The balance of the net revenue will be carried forward to the next half year.

William Graham Bradshaw, Chairman.

The Accounts.

The accounts accompanying the report consist of the usual set of statements. They show that the paid-up stock on the 31st of December amounted to £996,405; that £1,076,875 had been added by conversion, making £2,073,280; and that £149,298 remained unissued out of the total authorized capital (including premiums) of £2,235,000. The total amount borrowed on the above-named date was £339,062 10s., and £135,937 10s. was added by conversion; making a total of £475,000, and leaving £79,226 to be borrowed out of the £550,000 authorized. Capital account receipts amount, with premiums, to £2,606,065 4s. 5d. The expenditure stands at £1,450,225 5s. 10d., with a nominal amount of £1,212,812 10s. added by conversion—together, £2,663,037 15s. 10d. There is thus a balance of £56,972 11s. 5d. carried to the balance-sheet. A sum of £2348 was expended during the half year on new and additional mains, services, stoves, &c.; but as £1388 is credited for prepayment meters and fittings, the expenditure during the six months stands at £960. The reserve fund amounted at the close of the half year to £37,358, and the insurance fund to £32,038.

Revenue Account.

Expenditure.

Manufacture of gas—		
Coal and oil, including dues, carriage, unloading, and trimming	£92,005 18 7	
Salaries of Engineer and officers at works	2,773 9 0	
Wages (carbonizing)	10,859 17 4	
Purification, including labour	1,042 1 1	
Repair and maintenance of works and plant, materials and labour (less £287 17s. 4d. received for old materials)	32,720 2 0	
		£139,401 8 0
Profit sharing		3,765 10 8
Distribution of gas—		
Salaries and wages of officers (including rental clerks)	£5,184 19	
Repair, maintenance, and renewal of mains and services, material and labour	8,280 12 6	
Repair and renewal of meters	2,799 4 1	
" " " " stoves	10,969 17 0	
" " " " prepayment meters and fittings	11,506 13 3	
Incandescent mantle maintenance	869 6 8	
		39,610 12 10
Public lamps—lighting and repairing		2,752 5 4
Rent, rates, and taxes		14,961 17 8
Management—		
Directors' allowance	£1,250 0 0	
Company's Auditors	75 0 0	
Salaries of Secretary, Accountant, and clerks	1,089 1 7	
Collectors' salaries and commission	1,615 16 2	
Prepayment meter collection	3,310 2 2	
Stationery and printing	1,236 9 8	
General charges	1,715 17 1	
		10,292 6 8
Bad debts		512 10 4
Law and parliamentary charges		304 2 2
Superannuations and allowances and Workmen's Benefit Society, &c.		2,538 11 2
Official officers, &c.		123 18 7
National Health and Unemployment Insurance		470 8 0
Total expenditure		£214,733 11 5
Balance carried to net revenue account		78,617 4 3
		£293,350 15 8

Receipts.

Sale of gas—		
Per meter (number in use, 109,871) at 2s. 4d. per 1000 cubic feet	£195,715 8 11	
Public lighting and under contracts	5,604 14 5	
	£201,320 3 4	
Less discounts and allowances	4,004 19 5	
		£197,315 3 11
Rental—		
Meters (23,974)	£2,858 7 2	
Stoves (70,552)	11,261 3 8	
Prepayment meters (85,157)	17,847 2 3	
Incandescent mantle maintenance	795 14 0	
		32,762 7 1
Residual products—		
Coke, less £3115 6s. 7d. for labour	£36,827 17 1	
Breeze, less £827 10s. 3d. for labour	1,342 0 8	
Tar	12,025 10 2	
Ammoniacal liquor and sulphate of ammonia	13,026 0 9	
		63,221 8 8
Miscellaneous receipts—		
Rent receivable	£15 11 0	
Transfer fees	36 5 0	
		51 16 0
Total receipts		£293,350 15 8

Statement of Coal and Oil.

—	In Store June 30, 1912.	Received During Half Year.	Carbonized During Half Year.	Used and Sold During Half Year.	In Store Dec. 31, 1912.
	Tons.	Tons.	Tons.	Tons.	Tons.
Coal	19,521	94,661	94,821	847	18,514
Oil—gallons	291,995	1,675,039	1,460,288	..	506,746

Statement of Residual Products.

Description.	In Store June 30, 1912.	Made During Half Year.	Used During Half Year.	Sold During Half Year.	In Store Dec. 31, 1912.
Coke—tons	1,544	59,263	7,623	47,703	5,480
Breeze—tons	2,820	8,188	..	8,032	2,976
Tar—gallons	493,470	1,210,679	..	1,205,499	498,650
Ammoniacal liquor—butts of 108 gallons	5,949	33,564	31,610	..	7,903
Sulphate of ammonia—tons	145	1,004	..	1,009	140

Statement of Gas Made, Sold, &c.

Quantity Made.	Quantity Sold.		Quantity Accounted for.	Number of Public Lights.
	Public Lights and under Contracts (estimated).	Private Lights, per Meter.		
Thousands.	Thousands.	Thousands.	Thousands.	
1,842,301	36,783	1,678,852	1,743,269	3898

The remaining statement is the balance-sheet, which gives the value of the stores in hand at the close of the half year as follows: Coal, oil, &c., £18,302; coke and breeze, £4111; tar, ammoniacal liquor, sulphate of ammonia, &c., £11,186; sundry stores, £33,760—total, £67,359. The figures this time last year were: Coal, oil, &c., £22,251; coke and breeze, £4630; tar, ammoniacal liquor, sulphate of ammonia, &c., £11,141; sundry stores, £33,087—total, £71,109. A sum of £22,739 stands in the balance-sheet as employees' bonus and savings, compared with £21,170 at the end of December, 1911.

MIDLAND JUNIOR GAS ASSOCIATION.

Dinner and an Address.

There was a gratifying muster at the Colonnade Hotel, Birmingham, last Saturday, on the occasion of the dinner of the Midland Junior Gas Association. The party of about eighty which sat down included a number of distinguished visitors; and altogether the success of the first function of this character which has been undertaken by the Association was such that there is little doubt that it will be followed by others of a like nature. The chair was taken by the President (Mr. F. Shewring, of Droitwich); and those present included Mr. J. Ferguson Bell, of Derby (who after dinner delivered an address), Mr. Edward Allen, of Liverpool, Mr. R. S. Hilton, of Birmingham, Mr. W. S. Morland, of Gloucester, and Mr. Harold E. Copp, of West Bromwich (President and Hon. Secretary respectively of the Midland Association of Gas Managers), Mr. Kotaro Shimomura, of Osaka, Mr. Vincent Hughes, of Smethwick, Mr. Thomas Berridge, of Leamington, Mr. Charles Dakin, of Cradley Heath, and Mr. J. Foster, Dr. W. B. Davidson, Mr. J. Hewett, and Mr. E. W. Smith, of Birmingham. Among apologies for absence were telegrams from Mr. F. J. Bywater, Mr. B. W. Smith, and Mr. W. J. Sturges. In addition to the address, an excellent musical programme was interspersed with a few speeches.

Welcome—A Visitor from Japan.

The "Loyal Toast" having been honoured, the Chairman remarked that it was not often that a Junior Association were so honoured in the matter of their visitors; and he extended to the gentlemen present a hearty welcome—making special reference to Mr. Allen, as Vice-President of the Institution of Gas Engineers, and Mr. Shimomura.

Mr. Allen, in response, thanked the members for their welcome, and assured them of the keen interest taken by the Institution of Gas Engineers in the Junior Associations throughout the country. They all of them, he remarked, realized that youth would have its way. He saw juniors before him who would doubtless be the holders of distinguished positions in years to come. In fact, there were men who had to do with the formation of this Association a few years ago who had already been called upon to occupy prominent positions.

Mr. Shimomura said it was very difficult for him to tell them in a foreign language what he had in his heart; but he felt it was his duty to thank them for their kind words of welcome. When he came to this country, one of the first things said to him was, "You Japanese have made wonderful progress." He replied that it was certainly true that during the last forty years they had done all they could to learn, and now they had arrived at their present stage. Looking back over these forty years, there was one matter for which the Japanese must be very grateful, and that was, for the many things which they owed to England. In Japan, the foreign language which was read most was English. In fact, there were very few educated people who were not able to read it, though the number who could speak it was smaller. This showed what a great influence England had exercised in moulding the Japanese national character. They had always looked upon England as their teacher, and would continue to do so for many years to come. This was especially the case in connection with the gas industry. He regarded it as one of the most fortunate of his experiences that he had happened to be in Birmingham that day, and so was able to be present at their dinner.

Mr. Bell's Address.

Mr. J. Ferguson Bell (of Derby) then proceeded to give his address, which will be found below.

A hearty vote of thanks was passed to Mr. Bell for his address, on the proposition of the Chairman, seconded by Mr. Berridge, who recalled the first meeting held to consider the formation of the Association. To their first Secretary, Mr. James Hewett, he said, the Association owed more than to anyone else. He much regretted the absence, on account of ill-health, of Mr. Charles Meiklejohn, who had also taken an active part in the formation of the Association.

Mr. Bell, in response, said it had given him much pleasure to be present and deliver his little address; and he hoped he might be spared to attend other similar gatherings. When he asked Mr. Allen to accompany him, that gentleman had at once replied, "The claims of the young men are such that I feel I must be present." It was gratifying to learn that the Association was going forward by leaps and bounds; and he trusted this state of affairs would continue.

Two Toasts.

Mr. Hilton proposed the toast of the "Midland Junior Gas Association," and remarked that in their business proceedings he was glad to see the commercial side was not forgotten. If he might venture to make a suggestion, there was one subject in his mind which had not yet been dealt with in a paper—namely, the cost system in connection with gas-works. He did not mean the cost at the end of the year or half year, because everybody had this, but a system which started with the costs each week, and followed this up with the monthly cost. The weekly cost would remain, of course, the labour cost; but the monthly cost would include not only labour but materials. They had a complete system in Birmingham which he was sure was of advantage to everyone who came in contact with it. Nothing had struck him more, in coming into a new industry, than the goodwill, and the wish of everybody to pass on to others the knowledge that they themselves possessed. Between all gas undertakings one found there was an interchange of ideas and information which was particularly pleasant, and which reflected the greatest credit on all those engaged in the industry; and if this spirit of co-partnership, if he might so call it—a word which had been almost coined by the gas industry—continued to flourish, with the aid of Associations like this, he thought they would have no need to fear for the future.

The President, in response, thanked Mr. Hilton for the kind things he had said, and remarked that the Council would be very pleased to have submitted to them a paper on the subject suggested.

Mr. W. H. Johns proposed "The Visitors," and referred to the number of well-known gentlemen who were present. He also expressed pleasure at the fact that in Birmingham they were able to show Mr. Shimomura the latest systems of carbonizing, which he was desirous of seeing.

Mr. Copp replied, and remarked on the high standard which was maintained in the papers read by the members of the Association. It seemed to him right that such a meeting as this should be held in Birmingham, for events were transpiring in the city which he thought would shortly make it the Mecca of the gas industry. Birmingham was showing such enterprise and energy in connection with its gas undertaking that it was bound to bear valuable fruit, not only for the inhabitants of the city, but for the community at large.

THINGS THAT COUNT.

By J. Ferguson Bell, M.Inst.C.E., of Derby.

[An Address to the Midland Junior Gas Association.]

The invitation conveyed to me by your Secretary to give an address during this session, was of so cordial a character that I resolved at once to comply with the wishes of your Committee; one reason being that this Society, though the youngest, is one of the most vigorous. Its membership, I am informed, is now the largest of any of our Junior Associations; but what to my mind is of much greater importance, the work done compares favourably with that of the other Junior Associations, and there is a vigour and enthusiasm that bids well for the future. I find that this Association was formed in 1905-6, with a membership of just over 100; and in seven years' time the number has been practically doubled—there being a progressive increase each year. During this period, 39 papers have been read and discussed; many of them being of high technical value. Thirteen were on manufacture, ten on distribution, eight referred to residual products, two were on commercial subjects, and six on the physical and chemical aspects of gas manufacture. From this summary, it will be seen that the activities of the Association are so varied as to embrace almost the whole field of our industry. I have no hesitation in saying membership is a distinct asset; for, in addition, 27 works have been visited. The educational value of such inspections appears to me of the highest importance. No doubt you have, like myself, learned a good deal from visiting works—sometimes what to avoid, as well as what to emulate. I sincerely hope this high standard will be maintained, and would remind you that membership entails responsibilities on the part of all, to see that each does his part to continue to hold for your Society this very eminent position.

Magnitude of the Industry.

The magnitude and importance of the industry in which the members of the Association are engaged are perhaps best indicated by a brief reference to the Board of Trade returns issued in December, 1911, of all authorized gas undertakings in the United Kingdom belonging to both local authorities and companies. The totals of the returns are as follows:—

	Number.	Paid-up Capital. £	Receipts. £	Expenditure. £
Local authorities	298	42,490,504	10,829,758	7,902,451
Companies	511	92,193,191	20,446,438	15,308,928
	809	£134,683,695	£31,276,196	£23,211,379

	Gas Sold 1000 Cubic Feet.	Length of Mains in Miles.	Number of Consumers.	Public Lamps.
Local authorities	67,491,765	14,102	2,666,146	349,120
Companies	115,342,163	22,020	3,751,703	371,665
	182,833,928	36,122	6,417,849	720,785

These figures show the immensity of one of the most important public services, which has practically become a necessity of modern civilization; and the remarks I venture to address to you

may, I hope, tend towards improved practice, and enlarge the conceptions of your respective callings, as upon your ability depends, to a large extent, the continued success of our industry.

SOME GOOD ADVICE.

I observe sometimes in the Technical Press—to which, one and all, we are greatly indebted—a murmur of want of appreciation and inability on the part of some to command success, who so far have laboured hard to attain it. I can sympathize with them. But surely it is better to deserve success by a conscientious and diligent discharge of duties, and to continue to strive towards what is highest and best; for it should be remembered that enduring fame and true nobility are not confined to any position or individual, no matter how eminent, and that true greatness is not always associated with material success. If the position to which you aspire proves beyond your powers, you will at least have made some advance towards its attainment, and in so doing contributed to your proficiency, resulting in all probability in a more perfect performance of your duties—thereby contributing to your own welfare. We should remember in this life nothing is gained without great labour; and sudden changes, either in the affairs of empires or of individuals, are seldom productive of beneficial consequences.

Sir Corbet Woodall, whose well-merited knighthood has given general satisfaction throughout the gas industry, has already pointed out, very much better and more ably than I can hope to do, that, not only in the higher, but in other grades, salaries in many instances are pitifully low in comparison with the importance of services rendered—often involving high technical skill, and much ability and discernment. But however this may be in respect to those who occupy the higher positions, they at least owe it as a duty to the industry to see that their assistants and others are properly recognized and adequately remunerated. Also that the conditions of service are made such as to attract some of the best and brightest intellects to join our ranks. Otherwise our industry is likely to be impaired by inefficient service.

Dissociating reward proportioned to services, besides inflicting injustice, tends to inefficiency, hinders development, and is a barrier to stimulus; whereas recognition for special ability, energy, and faithful discharge of duties is calculated to promote fresh endeavours towards further progress, with a more vigorous and enthusiastic service. It should be remembered that all who desire to attain a position of trust and distinction must first obtain the confidence of their employers, by perseverance and unwearied exertions, together with the faithful performance of all duties in the best possible manner; for anything that is worth doing is worth doing well. And I would add that intellectual culture, untiring industry, with a high sense of duty, are the only sure and legitimate paths to promotion.

THE EDUCATIONAL SYSTEM.

Technical education, which means a knowledge of science in union with practice, has happily during the last decade made progress; but there is ample evidence that our present educational system—both elementary and secondary—is in many respects unsatisfactory, and calls emphatically for revision and putting on a more common-sense and rational basis. Mr. Walter Dixon, in a recent Presidential Address to the West of Scotland Iron and Steel Institute, called special attention to education. His criticisms appear to me so apt that I propose to briefly direct your consideration to this most important subject—more especially as many of those I now address come into personal contact with many of the younger men engaged in various callings. Mr. Dixon asks the pertinent question, What is education, and are we getting it? And he points out, first, that so far as education is concerned, everybody, however humble his class, should have as essential an equal share with those born in higher positions; and, secondly, that it is our duty to make every citizen, so far as is reasonably within our power, a worthy and intellectual citizen, fitting him to take a responsible share in the destinies of his country and race. Instead, has it not gone in other and more "high flown" lines, in which it has miserably and ignominiously failed?

Most people who have given education any serious consideration will agree there is unfortunately much truth in Mr. Dixon's criticisms. By our present system, manual labour is being looked down upon and regarded as akin to slavery; yet nine-tenths of the artizan classes must occupy themselves during their working hours with manual labour which is more or less semi-automatic, and in which school learning outside "the three R's" does not and cannot enter to any but a limited extent. There can be no doubt that school education, to be of any service to the great mass of our population, should be more directed towards laying a foundation for such as is likely to be of use in the duties and responsibilities of life.

The cry of educationists on all hands is for more; whereas I entirely agree with Mr. Dixon it should be less of that particular sort of education now supplied to the many who do not want it and cannot possibly profit by it. I believe with him we should find it advantageous to retrace many recent steps and curtail many extravagancies, taking care at the same time to keep an open door with facilities for those who desire special knowledge, no matter what their position or means may be. The powers of observation, instead of cramming to pass examinations, should be cultivated to a greater extent, and students taught to think for themselves. Manual labour should be exalted; for without it, either as work or pleasure, we cannot long remain healthy. There is a Latin proverb, "The gods sell us everything in return for our labour, toils, and exertions."

I very earnestly commend a revision of the system of indentured apprenticeship for all trades. There should be a closer adaptation in the elementary and secondary schools to the practical requirements of trades and callings that pupils in those districts are most likely to be engaged in. By this I mean in the agricultural or important industrial centres instruction in each should be directed towards the avocations in those centres, and facilities given to all apprentices to attend secondary schools; for if we are to maintain our industrial position, more attention will require to be given to theoretical and practical training in craftsmanship. The report of the Education Committee of the London County Council appointed to consider the question on apprenticeship embodies the experience of many employers on this momentous question, which is of national concern: "The case of the London boy is a particularly difficult one (this applies equally in many other districts); and it is so fatally easy for him to drift into some employment which, while the initial wages are high, offers no prospects for the future, and leads him inevitably when a man into the ranks of the unskilled labourer and casual labourer and the unemployed. It is so hard for him or his parents to discover, even if such be their wish, a satisfactory way of entering skilled labour."

It is this shortsighted practice on the part of parents and guardians that is responsible for the large and increasing number of unskilled workmen; and I am glad to notice in the "Engineer" last month a series of articles on the apprenticeship question, and trust they will be the means of stirring-up employers to see the necessity of a return to the old apprenticeship custom of executing a legal indenture between the parties, which shall be binding on both sides.

THE SHORTSIGHTEDNESS OF A POLICY OF CHEAPNESS.

Another shortsighted policy is cheapness in engineering, which is often illusory, as cheapness purchased at the expense of stability or quality is an expensive fallacy which cannot be too strongly condemned. It may and often has led to disaster, involving serious consequences to all concerned, and sometimes even to loss of life. Competition during periods of lessened demand results in keen struggles for work offered, with lowering of prices; sometimes to such an extent as to make it impossible to leave a margin of profit—that is, if proper and suitable materials and workmanship are to be used in carrying out the work. It is an unhealthy state of affairs in any industry if the articles made are sold at a less price than they can be produced at, and inevitably tends to inferior quality and slackness.

The cry for cheapness, irrespective of quality, has already in some respects gone too far, as in many contracts price alone appears, or is thought, to be the determining factor; whereas workmanship and ability to carry out the work, reputation of the firm, and suitability of the materials used, both in respect to strength and quality, instead of price alone, should be the determining factors. If it were made generally known that in all contracts a rigid examination of every article supplied would be made, and that quality and workmanship would count as well as price, then a well-deserved blow would be given to excessive cheapness at the expense of quality, even in time of severe trade depression.

It is, of course, not sound business to pay more for an article than it can be produced at, leaving a reasonable margin of profit to the producer. On the other hand, unless fair and reasonable prices are paid, the user is almost sure to suffer by a decrease in efficiency. When, owing to extreme competition, prices realized are unremunerative, it generally only lasts for a time. Combines and trusts result, with an enormous increase. Sometimes prices are then artificially inflated, so that in the end consumers are worse off. I am afraid, in some branches, we are now paying this penalty.

NEED FOR INVESTIGATION.

Fashion is a changeable dame in many other matters besides that of dress; and because certain things or processes are fashionable, it does not necessarily follow it is wise to adopt them. Circumstances alter cases, so that what is suitable in one case may be quite unsuitable in another. By all means gradually introduce the latest and best types of plant and machinery; but take care it is suited for the purpose it is intended to serve, as upon the results obtained you will be judged, not upon what you were led to expect. Original investigations should be undertaken and encouraged to a very much greater extent than at present. We suffer in our industry, as in most others. We want to see results in £ *s. d.*, instead of being content to wait with patience for full and complete investigations.

At all the larger works, a certain amount of original research work should be regularly and systematically undertaken by skilled technically trained assistants. Such investigations need not be costly; and the reward is often out of all proportion to the expenditure involved. I do therefore plead for greater facilities and more encouragement to be given not only on the part of those in authority, but in addition ask those in subordinate, yet important, positions to collaborate in working out problems, so that our industry may continue to advance. We cannot afford to stand still. Advances in science and industrial arts are continually being turned to useful account; thus any industry that stands still is sooner or later doomed to decay.

SULPHUR COMPOUNDS.

There are many important and far-reaching problems awaiting

solution in the industry in which we are engaged. Much has been accomplished. Formerly certain of the more valuable of the bye-products were useless waste—nay, worse, they were often a serious nuisance. Now for many years they have fortunately been turned to profitable account. This has not only materially increased the prosperity of the gas industry, but in addition vastly added to the wealth of nations by the production of valuable products—one, not the least important, being an artificial fertilizer available for the land, thereby increasing its productive power, and so benefiting the community at large.

The elimination of sulphur compounds from town gas at a reasonable cost and without creating a nuisance is one of the problems that remain to be solved. It is well known that the removal of sulphur compounds, when formed, is a difficult matter. Hence I think an investigation in respect to the mode of their formation in the hot retort is worthy of study. I find moisture in the coal appears to influence the quantity of CS_2 in the resulting gas. My experience is that when wet coal is carbonized, the sulphur contents in the gas are invariably higher. The sulphur impurities present in the coal, of course, exert an enormous influence on the quantity of CS_2 produced. If present in the form of calcium sulphate ($CaOSO_3$), it does not readily yield up its sulphur as H_2S or CS_2. But, on the other hand, if the coal contains pyrites or iron-disulphide (F_2S_2), this is readily decomposed at a low temperature giving ferric oxide (F_2O) and free sulphur. The former remains in the coke, and produces when the coke is burnt a reddish ash, and the sulphur goes as H_2S and CS_2 in the gas, according to the conditions and the method of carbonizing adopted. Now, H_2S is easily removed at a small expense; but it is the reverse with CS_2. So care should be taken to prevent, as far as possible, its formation in the retort. I find that, with well-filled horizontal retorts having ascension-pipes on each side of the bench, the sulphur compounds with average Derbyshire coal vary from (say) 35 to 40 grains; whereas with pipes on one side of the bench only the CS_2 is increased to 60 to 70 grains per 100 cubic feet.

In an Inaugural Address delivered by me to the Midland Association of Gas Engineers in 1900, I referred to the desirability of sulphur-free gas being supplied, and pointed out that the presence of 40 grains of CS_2 in the gas is not only noticeable, but harmful when used for lighting purposes in rooms badly ventilated (and unfortunately many rooms are defective in this respect). Gas containing 40 grains more or less of sulphur per 100 cubic feet will evolve upon combustion twice its weight in sulphur dioxide (SO_2), or three times of sulphurous acid (H_2SO_3). This, no doubt, is a very small quantity if comparison be made with the cubic contents of an ordinary room, and may appear almost inappreciable. But, as the late Professor Tyndall remarked, no chemist ever weighed the perfume of the rose; and yet we notice the difference when a bunch is brought into a room. Hence, though the difference between 20, 30, 40, or 50 grains in 100 cubic feet of gas which weighs 22,500 grains may appear imperceptible, yet it has an appreciable effect; and if the interests of consumers are to be studied, the sulphur impurities will be reduced to the lowest possible limit.

Furthermore, the CO_2 present in town gas should be as low as possible, as 1 per cent. of CO_2 means a reduction of at least half-a-candle in 17-candle power gas, and the poorer the quality so the lowering effect increases; and, further, gas containing much CO_2 burns with a dull red flame. Nitrogen in a similar manner is a harmful and useless diluent; and additional experience of twelve years has only strengthened and confirmed my opinion that the best interests of the gas industry are served by supplying at all times well purified gas of even quality. It is very much better to supply a good even quality gas than a high make per ton of coal used, which, of course, in itself is praiseworthy, but not at the expense of quality by adulteration with useless and even harmful diluents.

NAPHTHALENE.

The properties of naphthalene ($C_{10}H_8$) is a subject of special interest that is well worth systematic and careful investigation. This substance, under certain conditions, has the unfortunate property, so far as gas suppliers are concerned, of turning from a vapour into a voluminous crystalline solid. Hence a very small quantity is sufficient to cause a good deal of trouble, if allowed to be deposited as a solid. However, as one of your members, our highly esteemed Chief Chemist, Mr. G. F. Twigg, has already presented to your Association a very complete record of the investigations carried out at Derby, it is unnecessary for me more than to refer very briefly to this subject.

It is of interest I think to note that, though at Derby we are now sending out gas containing almost as much naphthalene vapours as previously, yet in 1901 we had 9574 complaints arising from naphthalene stoppages, with 18,000 consumers; whereas last year (1912) we had only 206 complaints, with 32,500 consumers. I think these figures are convincing confirmation of the views I have now for some years set forth—that it is not so much the number of grains of naphthalene in the gas distributed, but what is of much greater importance, if you desire to be free from naphthalene stoppages, is that you take care you have sufficient naphthalene solvents in the gas, so as to prevent it being deposited in a solid form. If the gas does not contain sufficient naphthalene solvents, then these should be added. A good solvent should, of course, contain as little naphthalene as possible before use, and be a fairly volatile liquid, that the gas can pick up and carry forward; and its dew point should be near the temperature at which naphthalene will deposit as a crystal. I should treat naphthalene as an impurity; but unfortunately so far no cheap liquid or solid that readily dissolves naphthalene is available, which does not at the same time absorb valuable naphthalene solvents.

What you require is to prevent, as far as possible, the formation of naphthalene in the retorts, and ascertain what conditions are favourable and otherwise in respect to its formation.

SOME OTHER MATTERS.

The lighting efficiency of incandescent gas-burners has of recent years been enormously increased; but much remains to be done. Even the best and most efficient high or low pressure incandescent burners are enormously wasteful in heat energy utilized in producing light. I look, in the near future, for great advances in the direction of more useful utilization of heat energy into luminous rays. Compare the energy expended by a fire-fly to produce the fascinating flashes of light, with that used by the most scientific and economical methods of present artificial illuminants.

The gas-turbine is another problem in motor-power construction. When this is solved, it will give an immense impetus to the use of gas for motive-power purposes; and we may reasonably expect sooner or later the production of a gas-turbine which will excel the steam-turbine in heat efficiency, as the internal combustion reciprocating engine already excels the steam-engine. It is well known that the steam-turbine for small powers has not so far fulfilled expectations, though of late years it has made enormous strides in large power plants—being more economical in steam consumption, occupying much less space, requiring less attendance, and possessing constructive simplicity. I am inclined to think the gas-turbine will, at least in the first instance, probably be better suited for small than large powers, in consequence of high working temperatures necessary to be encountered. There are many constructional difficulties yet to be overcome. Probably a practical solution lies more in the direction of an explosion turbine than a uniform pressure turbine.

In the distribution of gas, higher pressures are rapidly coming into practical use; and there is no doubt considerable economy may be effected by this means, and also by supplying from high-pressure feeding mains into low-pressure mains. When laying high-pressure mains to feed into low-pressure ones, by pressure reducing governors, it is important that there are no sharp right-angle bends upon the high-pressure mains; otherwise oscillations in pressure may occur. We laid, some three years ago, a direct high-pressure main, about 3 miles in length, to supply an outlying district, and were for a time perplexed to find considerable oscillation in pressure, which affected the governors and caused inconvenience to consumers. I thought there must be a low place somewhere in the main allowing water to accumulate, which, when a quantity of gas was passing, started oscillations. An examination at various points failed, however, to trace any water. The pressure-reducing governors were then examined, but all to no purpose. It was not until we located a place where the pressure varied most that we found the cause was an acute right angle. Upon taking this out, and giving the gas an easy flow, all oscillations at once ceased.

I am of opinion that there should be a pressure of not less than 3 inches in the distributing mains, and that a reliable governor should be fixed on the inlet of consumers' meters, so that uniform pressures of from 22-10ths to 25-10ths may be maintained upon the fittings. Inverted incandescent burners are most sensitive to variations of both pressure and quality of gas. These are the types of burners that are rapidly displacing vertical ones; and if consumers are to be satisfied, it is necessary for an even pressure to be always given, both at the lighting points and for gas-fires and cooking-stoves, to obtain the best results. I am of opinion that the comparatively large variations in pressure that occur in some towns are responsible in many cases for consumers not being satisfied with the gas supply.

My remarks have been of rather a fragmentary character; the object being to inspire members of the Association to press forward to conquer some of the more pressing problems that are waiting to be solved, and so win fame and further promote the success of our industry. If I awaken the spirit of inquiry in any, then I shall be compensated a thousand-fold for any time spent in putting forward these thoughts for your consideration.

An ordinary meeting of the Illuminating Engineering Society will be held at the Society of Arts rooms, John Street, Adelphi, on Tuesday next, when a paper dealing with "Shades, Globes, and Reflectors" will be read by Mr. J. G. Clark and Mr. V. H. Mackinney.

Mr. William Coulson Parkinson, the Chairman of Messrs. Parkinson and W. & B. Cowan, Limited, whose death was recorded in the "JOURNAL" for the 7th ult., left estate of the gross value of £294,474, with net personalty amounting to £289,149. The duties on the property, at this valuation, will come to about £35,000.

At a recent meeting of the Royal Society, Dr. F. W. Edridge-Green dealt with the subject of colour adaptation. As in dark adaptation there is a considerable effect immediately on entering a dark room, so is there when a person enters a room illuminated by an artificial light, having previously been in daylight. This effect, which may be designated "colour adaptation," increases with the time during which the eyes are subjected to the adapting light.

ILLUMINATION OF ENGINEERING WORKSHOPS.

Comparison of Gas, Electric Light, and Incandescent Oil.

As briefly intimated in the "JOURNAL" last week, a recent meeting of the Manchester Association of Engineers was devoted to a discussion of the subject of the "Illumination of Workshops;" the merits of gas, electricity, and incandescent oil being set forth in papers read by Mr. Franklin Thorp, of Manchester, and Messrs. Haydn Harrison and J. E. Evered, of London. Mr. Thorp's paper has already been given (*ante*, p. 321); and we now give the principal portions of the other papers with a report of the discussion which ensued.

LIGHTING BY ELECTRICITY.

Dealing with this subject, Mr. HAYDN HARRISON said: It must be borne in mind that the work usually carried out in engineering workshops has to be of an accurate nature. This means that not only every detail of the work shall be clearly visible to the worker, but also that such defects in lighting as might cause a strain on the nervous system should be carefully removed. Under these circumstances, glaring lamps must be avoided, with the result that illuminating engineers have designed, and are now generally adopting, types of reflectors which prevent the actual lamp filament being visible under working conditions. Moreover, these reflectors or shades so increase the candle power or useful rays in the required direction, that the cost of electric lighting is reduced to such a figure as to make it doubtful whether any other form of illuminant could compete.

Before dealing with the artificial illumination of any interior, it is wise to investigate the daylight conditions as they considerably affect the requirements of the workers. For example, a series of recent tests show that the artificial illumination of some automatic screw-cutting machines varied between 9 and 15 foot-candles; whereas the daylight illumination on the same machines was only 3 foot-candles. In another case, the daylight illumination was 37 foot-candles; the artificial illumination being 133 foot-candles. This tends to prove that the workers prefer a higher degree of illumination than is sometimes obtained during the daytime; and those who have noticed how often a workman will employ an electric hand lamp during the daytime will, no doubt, have come to the same conclusion.

In America, where this subject has received very special attention, probably on account of the high price paid for labour, which has resulted in every effort being employed to increase the output per man, the following values are considered essential in machine-shop working:

	Foot-Candles.
General illumination only, where additional or special illumination of each bench or machine is provided	1·5
Bench illumination	4·0
Machines, or machine shops with no local illumination	6·7
Foundries, general illumination	3·0
Power-houses, general illumination	2·5

The above figures may be taken as a very good guide; and no doubt the point which will interest you most is how to obtain such results without depreciating the value of the illumination obtained by the introduction of glare or other defects, and at the same time keeping the cost within reasonable limits. The important points to be taken into consideration are mainly: (1) The position of the light unit. (2) Efficient shading.

In the American figures just referred to, it will be noted that the general illumination was put at 1·5 foot-candles. Your President suggested that in order that this paper might have some common basis of comparison with the others on the same subject, an example of this nature should be taken, and that costs should be given. The example suggested is that of a workshop having two bays, one 250 feet long, 50 feet wide, and 30 feet high, given up to heavy machinery; the other, 250 feet long, 30 feet wide, and 15 feet high, devoted to small machinery. The writer has taken for granted that the specified minimum illumination—viz., 1·5 foot-candles—applies to horizontal illumination on the floor in the case of the heavy machinery bay, and on the benches or tool-beds in the case of the small machinery bay.

The large bay being lofty, there are few objections to the use of high candle power units suspended as high as possible, so as to be well out of the line of sight of the workers, as it is obvious that the intrinsic brilliancy of such units will be higher than the regulations relating to glare would permit. In this case, as all the light is to be directed into the lower hemisphere, no better lamp could be adopted than one of the modern types of electric flame arc lamps. The width of the building being 50 feet, it naturally follows that if a line of lamps is placed down the centre of the roof near the apex they should be spaced at a distance of 50 feet. Thus, each covers an area of 2500 square feet. The total area being 12,500 square feet, five lamps would be ample; and these could be conveniently run in series on any circuit between 200 and 240 volts—a pressure now becoming usual in works.

To ascertain the candle power of the lamps required to produce a minimum of 1·5 foot-candles on the horizontal plane, it is only necessary to take the maximum distance of the sources of light from the likely point of minimum illumination which would be near the edge of the building, half way between two lamps (provided there is no light reflected from the walls). This distance is 46·4 feet. Then the simplest method is to multiply the illumination by this distance cubed, and divide it by the height of the light source, to allow for the angle of incidence; the result being divided by two, as the illumination is produced mainly by two lamps. This calculation works out as follows:—

$$\frac{1{\cdot}5 \times 46{\cdot}4^3}{30} \div 2 = 2437\text{-candle power.}$$

Thus, if the lamps produce (say) 2500-candle power at angles from 40° downwards, the necessary illumination will result. Actual practice has proved that a 500-watt flame arc lamp can be relied upon to do this. Thus five such lamps, taking a total of 2500 watts, will be sufficient. The cost of running such lamps depends mainly on three factors: (1) Cost of electrical energy. (2) Cost of carbons and trimming. (3) Interest and sinking fund and repairs. For the purpose of comparison, the cost of electrical energy is taken at 1d. per unit; this figure being chosen for reasons stated later. The cost of carbons and trimming for this class of lamp is generally found to work out at 0·3d. per lamp-hour. Interest, sinking fund, and repairs are taken as 15 per cent. on the capital outlay, which in this example would be easily covered by £50 for the large bay. On this basis, the cost of working comes out as follows for 1000 hours of lighting:—

2500 units at 1d.	£10	8	4
Carbons and trimming, at 0·3d. per lamp-hour.	6	5	0
Interest and sinking fund and repairs	7	10	0
Total	£24	3	4

Total cost of lighting the bay per hour, 5·8d.

The small machinery bay cannot be dealt with in the same manner, partially on account of the height being only 15 feet, and more particularly on account of the different class of work carried on there. In this case, the postulate is taken as 1·5 foot-candles measured on a horizontal plane 3 feet above the floor level, which roughly represents the level of the benches, lathe-beds, and similar machinery. For this class of work shaded lamps would necessarily be adopted; and the modern illuminating engineer would probably avail himself of one of the opaque patterns of reflector supplied specially for the purpose for use with tungsten lamps. These are generally designed to produce an even illumination when the light units are spaced at a distance apart equal to about twice the height of the lamps above the working plane. If the lamps and reflectors were placed 13 feet from the floor level and 10 feet above the working plane, each lamp would cover an area of 400 square feet. Thus twenty such fittings would be necessary. As with these fittings the light on the working plane is equal to double (or even more) the horizontal candle power of the lamp, one 50-watt lamp in each fitting would give the necessary minimum horizontal illumination. Thus this bay would take 1000 watts, or 0·133 watt per square foot.

Working out the costs in the same way as the large bay, we have to consider the cost of lamp renewals, which may be taken as 2s. 6d. per fitting per 1000 hours, interest, sinking fund, and repairs at 10 per cent., which, allowing the capital cost as £30 for fittings and wiring, works out as follows:

1000 units, at 1d.	£4	3	4
Lamp renewals	2	10	0
Interest, sinking fund, and repairs	3	0	0
Total	£9	13	4

Total cost of lighting the bay per hour, 2·32d.

These figures are instructive for several reasons; the most important being the difference in cost between lighting with large and small units. The cost of lighting the large bay with a total candle power equal to 12,500, or one candle per foot, is two-and-a-half times that of lighting the small bay with twenty 45-candle power lamps, which in the reflectors give 100-candle power in the desired direction, or a total of 2000-candle power.

The following figures bring this out more clearly:

Large Bay (12,500 *Square Feet Floor Area*).

Efficiency of lamps in required direction	5 C.P. per watt
Total candle power allowed	12,500
Candle power per square foot	1
Cost per square foot per 1000 hours	0·464d.

Small Bay (7500 *Square Feet Floor Area*).

Efficiency of light sources	2 C.P. per watt
Total effective light allowed	2000 C.P.
Candle power per square foot	0·267
Cost per square foot per 1000 hours	0·31d.

The writer has always considered that, for the purpose of comparison, the floor area forms an incorrect basis. He thinks that,

when dealing with the illumination of machine-shops, the cost of illumination per man would be a better basis to work upon, and is therefore worthy of careful discussion. He has looked at the question from this point of view, and finds that a basis of 10 watts per man for local lighting, *plus* a small amount for general lighting, should prove ample for general work, provided, of course, that suitable efficient opaque reflectors are adopted.

Local lighting cannot be conveniently carried out by means of gas, as small light units, such as 20-candle power, are not efficient when using a flame source, and are, moreover, not adapted for use in efficient reflectors, on account of the heat given off and the proximity of the operator to the products of combustion. For reasons such as these, the public bodies naturally utilize and recommend the use of electric light; but it should be unnecessary to cite examples to engineers who have, no doubt, learnt already the effect of gas on the working capacity of their employees. As regards degree of illumination, statistics have been obtained and published showing that defective illumination is often responsible for a decrease in output varying from 12 to 20 per cent. On the other hand, I trust this paper will have proved that efficient illumination can be obtained by the use of electric lamps, correctly spaced and shaded, at a cost which is probably lower than any other type of illuminant. This fact, combined with the valuable hygienic properties associated with electric lighting, has resulted in nearly all large employers of labour adopting this means of artificial illumination. The smaller employers will, no doubt, follow their example when they realize the benefits which would result both to themselves and their employees.

LIGHTING BY INCANDESCENT OIL.

In the course of his paper, Mr. EVERED pointed out that every factory really requires to be treated as a separate problem, and to receive the kind of illumination specially suited to the work done. For example, in shops where large objects are carried out—foundries, machine shops, goods yards, &c.—the provision of a general illumination by powerful lamps placed high up will be considered best. A great deal of discussion has taken place as to the amount of light necessary in such cases; and the impression seems to be that, while 0·5 to 1 foot-candle may be enough to enable people to see their way about, 2 to 4 foot-candles is nearly always desirable where any close work has to be done. Assuming the lamps are to be hung a sufficient height to preclude any possibility of glare, we have next to consider whether they will distribute the light evenly, and what is the correct spacing for them. There are also other cases, such as work at the lathe and bench, when very fine detail has to be examined, where a strong local illumination from well-shaded lamps may be necessary. This is obviously a factor which may have an important bearing on the choice of an illuminant, since it is not always easy to provide local shaded lamps of the requisite candle power. He mentioned one other illustration of such special circumstances. When very complicated machinery is to be examined, the perfection with which the light is diffused in all directions is most important. The illumination should, he said, be schemed-out so that the light can get into all corners and crannies.

Having referred to the early use of oil for lighting purposes, and to various methods of utilizing it as an illuminant at the present day, the author came to the Kitson oil-vapour system, with which he is associated, and which he considers pre-eminently adapted for factory lighting. He described it in detail, with the aid of illustrations of lamps, one of which was the "Still," using inverted incandescent mantles. Besides the simplified construction of this lamp, the use of an inverted mantle had, he said, proved decidedly beneficial. He added that mantles of this kind seem particularly suitable for incandescent oil-lighting from the standpoint of efficiency, and they are less fragile—an important point in the case of lamps which are carried from place to place, and apt to be subjected to rough treatment. The safety of the system, and the high penetrating power claimed for the rays of light produced by the Kitson lamp, were emphasized by the author.

Passing on to deal with the question submitted for consideration, Mr. Evered first of all showed on the screen some typical examples of installations of methods of lighting recommended for the solution of the problem, and gave the following figures of running costs, which he thought quite justified the statement that the cost per 1000 candle-hours with the Kitson lamps was generally less than 1d.

Large Shipyard.

	Shipyard.	Fitters' Coppersmiths' and Pipe-Bending Shops.	Engine Works, Machine and Erecting Shops.	Total.
Number of lights installed .	117	24	172	313
Total, 1000 C.P. × hours .	61,941	9681	65,328	136,950
	Pence.	Pence.	Pence.	Average.
Cost per 1000 C.P. per hour—				
Labour (attendant) . .	0·643	0·576	0·567	0·602
Oil consumed	0·275	0·393	0·454	0·369
Repairs and upkeep, exclusive of depreciation	0 377	0·304	0·128	0·253
Total	1·295	1·273	1·149	1·224

Large Machine Shop.

The following figures show the cost of burning thirteen pressure oil-lamps of 1000-candle power in a machine shop, from April 1, 1910, to March 31, 1911, a total of 16,654¼ lamp-hours:—

		Cost per 1000 C.P. Hours.
Attendants' hours, 831, at 4·44d. . .	£15 7 10	0·222d.
Oil, averaging 4d. per gallon . . .	26 0 3	0·375
Mantles, &c.	10 13 1	0·153
Total	£52 1 2	0·750d.

Large Engineering Works.

The following figures show the cost of 89 lamps in use from Oct. 1, 1911, to Sept. 30, 1912:—

Oil	£302 4 5
Mantles, gauze, rods, &c.	150 4 11
Gas	35 0 0
Labour	100 9 1
Total	£587 18 5

From these figures, the cost is estimated at 0·66d. per 1000 candle-power-hours.

Coming to the problem of lighting the bays in the machine-shop, Mr. Evered said: Let us take first the two large bays, each 250 feet long, 50 feet broad, and 30 feet high, which are devoted to heavy machine tools and the erection of machinery. For such work, some authorities consider a general illumination on the working plane of about 2 to 3 foot-candles. Personally, I think it is better to err on the right side; and the method of lighting I propose should give quite 3 to 5 foot-candles on a working plane 3 feet above the ground. Taking an average of 4 foot-candles, I estimate that each of these big bays would require about 16,000-candle power; and it has been laid down that, with high-pressure oil lighting, the running cost per 1000 candle-power-hours should not exceed 1d. A rough estimate, therefore, suggests a running cost per hour of 1s. 4d. per bay.

The new inverted burner lamps would preferably be employed. They would probably be hung at a height of 14 to 16 feet—well below the probable level of the travelling crane. Such lamps possess a distribution curve approximating to the "extensive" type, and may be conveniently spaced at a distance apart about equal to twice their height. We may therefore propose two sets of eight 1000-candle lamps, hung off brackets from either side of the bay, and projecting from 6 to 8 feet from the wall or pillars to which they are attached. The distance between lamp and lamp across the bay will be from 34 to 38 feet; and the distance between successive lamps down the line about 32 feet, which complies well with the spacing for uniform illumination. The running cost of the 32 lamps required for both bays will be about 2s. 4d. per hour. The initial cost of supplying lamps, piping, and everything necessary will depend upon the conditions, but will probably not exceed £192.

The three small bays, each 250 feet long, 30 feet high, and 30 feet wide, will only require a single row of eight lamps down the centre of the room, at about the same height as before. As these bays are devoted to small machinery, a good local illumination of 3 to 4 foot-candles will certainly be necessary; and this will be provided. The central arrangement is also an advantage, in that it will keep the lamps clear from the belts, which will probably be most of them located at the sides of the room. Should the number of belts be very considerable, it might be desirable to use twice the number of 500-candle lamps. The running cost of the lamps in each of these small bays should not exceed 8d. per hour—*i.e.*, 2s. per hour for the three bays. The cost of the installation for the three bays would probably not exceed £144.

DISCUSSION.

The CHAIRMAN (Mr. Charles Day), in opening the discussion, said that, when writing to the authors of the papers, he thought if it were possible to get each of them to give exact information regarding one particular case, so that they could bring the various estimates on to a comparative basis, it would be an interesting feature. He accordingly suggested to them a shop consisting of two bays, each 50 feet span (one being devoted to the erection of heavy machinery and the other to heavy machine tools), and three small bays, 30 feet span and 15 feet high, devoted to fitters' work and small machine tools. To some extent, the suggestion had brought out a few comparative figures, but not to the extent he had hoped for and desired.

Mr. J. G. NEWBIGGING said his observations would be confined to gas and electricity, because he considered that where there was a cheap supply of either of these commodities, oil was out of the question. In the first place, the price of gas or electricity was constant, with a tendency to a gradual reduction as economies were effected in the cost of plant and working. Oil, on the other hand, was subject to a fluctuating market; and Mr. Evered had not given any information as to the present price of oil suitable for his system of lighting. Twelve months ago it was about 4d. per gallon; but now it could not be obtained at less than 8d., even for a contract. It was clear, therefore, the cost of the system espoused by Mr. Evered must fluctuate very much indeed. It was a coincidence that the three authors had agreed as to the necessity of a high amount of illumination—4 to 5 candle-feet—from the points of quality and output of work and safety in carrying it out. The rules quoted by Mr. Thorp from the "Illuminating Engineer" were also of considerable value, and really gave the essence

of what good lighting should be. There were, however, two points not included in the last rule—namely, quality of light and reliability of supply. With regard to the former, he did not think that sufficient attention had been given to it, because his opinion was that quite as much injury was done to the eyes of workpeople from the bad quality of the light as from an insufficient quantity of it. This was an important point to be considered when workshops were being lighted, where men had to keep their eyes fixed on a special object. As to the respective costs of gas and electricity, 2s. per 1000 cubic feet was the price at which in the future gas would be sold to the Manchester consumer, whether large or small. As to electricity, he thought 1d. per unit was a very low figure for a small consumer. Judging by the dividends gas companies paid, as compared with electricity companies, this certainly seemed to be the case. With the price of gas at 2s. per 1000 cubic feet and electricity at 1d. per unit, the cost per 1000 candle-hours of illumination came out at practically the same figure—electricity being 0·67d. and gas 0·52d. In dealing with the capital cost, Mr. Harrison mentioned £50 as the price for equipping one large bay with five 2000-candle lamps; but the actual price quoted to him (the speaker) was £9 15s. 6d. for each lamp—a total of £48 17s. 6d., which left only about £1 2s. 6d. for wiring, switches, fuses, &c.—a very low figure.

Mr. HARRISON: They quoted you a very high figure.

Mr. NEWBIGGING said he should like the author to give an explanation as to this. On the other hand, Mr. Thorp told them he was prepared to carry out the work at a price he mentioned. It would be interesting to know whether Mr. Harrison would make the same offer; because if he did, he would get plenty of orders that evening. With regard to high-pressure gas-lamps, Mr. Harrison might be sceptical as to the efficiency of 50 to 60 candles, particularly after some recent experiences he had had in Manchester; but, as he knew, there were explanations of what occurred. Although possibly high-pressure gas had not made much headway in the direction of lighting engineering workshops, there was no doubt it had made considerable progress in the lighting of textile factories, and, in fact, had displaced electricity in many instances. One firm alone had fixed 50,000 lamps for the lighting of textile factories during the last two seasons.

Mr. EASTMAN said the last speaker stated that electricity had been ousted by high-pressure gas; but there were also instances where the opposite had taken place. Within the last few months, under his personal supervision, they had ousted three high-pressure gas systems principally on the question of cost. The firms had their own plant, and found they could generate electricity at practically ½d. per unit; and on this basis, of course, it would show a saving of at least 50 per cent. In one instance they had very great trouble with the mantles; but the worst cases in this respect—and perhaps there were reasons for it—were dye-works. The moisture attacked the mantles, and trouble followed. On some days they had as many as a quarter of the mantles to renew. One great evil in connection with the gas and oil systems was the amount of glare. If a man who had been attending to close work on his lathe raised his eyes, and in his line of vision there were twenty lamps of 1000-candle power each, when he looked back at his work he would be unable to do it—the pupils of his eyes having contracted to such an extent. With electric light, they had used 0·5-candle power, or even less, and yet the workmen had been able to see very much better. Gas and oil advocates did not seem to use any special reflectors. In narrow engineering shops, where the lights were placed at the side, the gas people principally used hanging lamps; but electricians had found that where it was really necessary to light from the side they were not nearly so efficient as a special type of angle reflector. He was aware that in some instances they might be used; but, generally speaking, gas engineers did not pay the attention to illuminating work that electricians did. Advocates of gas took the point that in all engineering works the current would be brought from outside. But that was not the case—many works generating their own at a cost of not more than 0·5d. per unit on the average. Leaving out any question of partisanship, there was no doubt it was a great advantage to increase the illumination of workshops in a proper manner, without causing excessive glare, which only made the conditions worse than before. Though the advocates of gas and electricity were naturally opposed to each other, they were all endeavouring to improve the illumination of workshops for the benefit of the industrial classes, because there could be no doubt that it was quite as important a matter as their general health conditions, which were already arranged for by the Government.

Councillor W. KAY, Chairman of the Gas Committee of the Manchester Corporation, doubted whether it was better for the proprietors of workshops to generate their own current in preference to buying it from an outside authority; the little extra cost involved by the latter being more than compensated for by the fact that there was no worry as to the source of supply. The quality of the light in a workshop was of the greatest importance; and the nearer they could approach to daylight the better.

Mr. S. L. PEARCE, the Electrical Engineer to the Manchester Corporation, said that, speaking frankly, he honestly believed the modern system of high-pressure gas lighting was an excellent one. But, after all, the matter resolved itself into one of pounds, shillings, and pence; and on this point he had never entertained any doubt that electricity "had the pull." On the question of the comparative bases of illumination, he thought Mr. Thorp and Mr. Harrison were very much nearer together than they imagined, though one expressed his results in terms of minimum horizontal illumination of 1½ candle-feet measured on the ground, while the other expressed them on the surface normal to the source of light. These differences taken into account, he did not think there would be much to choose in the average illumination in the two cases. With regard to the figures quoted for the gas costs, he should like to refer to the quantity of gas which Mr. Thorp worked out, at 2s. per 1000 cubic feet, as 14·6d. He (Mr. Pearce) tried to check this; and disallowing any figure for the 100-candle power lights (as to the consumption of which they had no data), and taking the consumption for the high-pressure lamps on the basis of 50 candles per cubic foot, and 15 candles for the low-pressure lamps, and the price at 2s. per 1000 cubic feet, he had 18·4d. instead of 14·6d. Another point was that while Mr. Harrison had throughout included 15 per cent. for capital charges, Mr. Thorp had omitted this item altogether, which, of course, would make a substantial difference. For the purpose of comparison, he would exclude interest and depreciation, so as to bring all three into line. Taking the authors' own figures (the 50 candles per cubic foot and the prices as given in the papers), he arrived at these results per 1000-candle power per hour: Electricity at 1d. per unit, 0·475d.; gas at 2s. per 1000 cubic feet, 0·645d., and at 1s. 6d. 0·618d.; and oil, 0·878d. The capital costs of these three systems were: Electricity, £160; gas, £225; oil, £336. The total running costs per hour (again excluding interest and depreciation) were: Electricity, 1s. 2¾d.; gas, 1s. 6¾d.; oil, 4s. 4d. It was only fair, in the last case, to point out that the total illuminating power provided was no less than 56,000 candles; while gas was 29,000 and electricity 31,000 candles. As far as he could put the results together on a common basis, he believed these figures to be reasonably accurate. Reference had been made in the papers to the possibility of prices coming down in the future. He could not speak for oil; but, judging from the market, he should rather imagine the tendency in this case would be the other way. As regards gas and electricity, however, the reasonable tendency was undoubtedly for them to come down. So far as electricity was concerned, he was perfectly certain that the outlook was hopeful; and it would possibly be through the help of their gas friends that they would be able to cheapen production.

Mr. LEES (of the British Westinghouse Company) said Mr. Thorp, in his summary of the advantages of gas, included "ease of manipulation." He (Mr. Lees) took it that this included the changing of the mantles and the whole business of cleaning and so on; and, in his opinion, when compared with the metal filament lamps, no advantage could be fairly claimed. Mr. Thorp also suggested that no special knowledge was required to keep the installation in perfect order, as was the case with the competitive systems. In reply to this, he would say that no great knowledge was needed for the ordinary wiring of a shop for electric lighting; and even in the case of arc lamps, where a certain amount of regular attention was required, it was not a costly item. Another advantage claimed for gas was the probability of improvement in efficiency. This applied rather more to electricity than to gas. There were far more ways in which the cost of electricity could be reduced than there were in the case of gas, because gas was dependent upon coal, and the price of coal was going up.

Mr. NEWBIGGING: No, it is not.

Mr. LEES: To a large extent.

Mr. NEWBIGGING: No.

Mr. LEES went on to say that Mr. Thorp, when referring to one of his illustrations, said the lights were 14 feet high. To his (the speaker's) mind, this would be a rather glaring light for a man working on a tool and looking up, because, after all, 14 feet was not very high for a powerful lamp. As to the pictures put on the screen illustrating the application of oil, he thought Mr. Evered was to be congratulated on his courage in showing them, for they were not very good examples of illumination; the glare being excessive on many of them, while the lights appeared to be quite unshaded.

Mr. COOKE said the special point he should urge was the avoidance of glare; and the glass they manufactured very considerably relieved this. He thought that with 3 foot-candles he would be able to see the surroundings better than with 4 foot-candles, provided the lights were carefully arranged.

Mr. REID said his firm had been interested lately in the question of the best means of illuminating an engineering shop. One of their places was 60-feet span, with a gallery running round it, and perhaps 140 feet long. They illuminated this shop by arc lamps hanging in the roof, so that the travelling crane lay underneath, and for the machines they had local lights, some of which were gas. They had now taken out the arc lamps and replaced them with metallic filament lamps, using about the same amount of current as they did before. They tried various sizes of lamps in different groupings, and hanging them in various positions in the shop; and they found that a great deal depended on the reflectors which were used. At the finish they thought they had discovered the best result by hanging a row of lamps down the centre, with a reflector giving more vertical than horizontal rays, so as to concentrate the light into the shop, and avoid the shadows so often found where ordinary arc lamps were used without proper reflectors. They spent a considerable time in deciding upon the position of the lamps, and tried the method of carrying them on swinging brackets. His experience of them was that they were a great nuisance in a shop where there was a travelling crane, because sooner or later they were struck by it, or by the object it was carrying. No doubt they were swung out of the way; but

considerable damage was done in the process. Dealing with the question of illuminating parts of the shop where small and medium-sized machine tools were fixed, the speaker said nothing would do but individual lighting; and with a proper kind of reflector they had obtained exceedingly good results.

Mr. Gass said he was in the peculiar position of having used the three systems of lighting referred to, except that the gas was on low instead of high pressure. First they put in the foundry high-pressure oil lighting, comprising ten lamps of 1000-candle power each. They thought this was not sufficient, and increased the number. They certainly got more intense illumination, but, rather strangely, the more lights they put in the foundry the more candles the moulders used. The explanation was that, owing to the intense light, if a moulder looked up, he could not see when he returned to his moulds, and required a stronger light to get into them. The oil-lamps were then taken out, and replaced by incandescent electric lighting, using high-power filament lamps. A number of 50-candle lamps were placed all round the foundry, just below the crane race; and though the light was nothing like so intense as with oil, the general results were better. There were few shadows, and the men worked more satisfactorily. They had also used low-pressure gas-lamps; but the substitution of the electric light improved the illumination generally. As to the comparative cost, his experience was that, generally speaking, electric lighting was not so cheap as the other systems.

A vote of thanks having been accorded to the authors,

Mr. Thorp, replying to the remarks on his paper, said his figure of 14·6d. for maintenance, even taking into account the 100 small lamps, was quite correct. It was true he had not allowed anything for depreciation; but, taking this at 15 per cent. on the £225, when they reduced gas and electricity to the same basis they would find that, instead of Mr. Pearce's comparison of 0·475d. for electricity with 0·645d. for gas, the results were practically reversed. The total capital cost of oil was given at £336, electricity at £190, and gas at £225; but, as Mr. Newbigging had said, in the case of electricity only £1 2s. 6d. was allowed for fixing five lamps, and doing the wiring and everything else. If additions were made for these things, the cost of the electric installation would get beyond the £225. Then again, if they were to take the price of gas direct from the high-pressure main, just as electricians were taking current from the town main, the capital cost for gas would be reduced to £110; showing that the more they got upon a proper basis, the better gas came out. Mr. Eastman had referred to reflectors; and, in reply to the criticism on this point, he would only say that gas men could use any reflector that the electrician used. With regard to the employment of incandescent gaslight in dye-works, it was true that the ordinary incandescent lights were not much use in such damp places; but, on the other hand, the electric arc lamps were not worth much in dye-works and bleach-works. He knew of two or three places where they had to be taken out on account of corrosion. At the Manchester University, a few weeks ago, he exhibited a lamp which would burn under water; so that a little steam would not do it much harm. Reference had been made to the fact that proprietors of workshops could generate their own current at ½d. per unit. A few years ago, he obtained particulars from some Oldham mills, where they ran their own dynamos, as to the cost of the electricity when compared with the then existing low-pressure system of gas lighting; and, after taking into account capital expenditure and depreciation, gas came out a long way ahead of electricity. As to the quality of the light, it was interesting to know that in the Manchester Royal Exchange gas-lamps were now being used instead of electric lamps; and the much pleasanter effect of the former was preferred to the coloured flickering light of the latter. Though the gas-lamps were put in originally as a stand-by, they were now being generally used, and the electric lamps were the stand-by.

Mr. Harrison said he should like to ask Mr. Thorp about the 100-candle power lamps which took only 2 cubic feet of gas. He had measured lamps many times, and was not in the habit of getting 100 candles for a consumption of 2 cubic feet of gas with a small burner. Mr. Thorp had stated in his paper that the efficiency of a mantle went up very rapidly in proportion to its temperature. The filaments in electric lamps were practically the same material as that of which gas-mantles were made, and were working at a temperature 50 per cent. above that of the mantle. Therefore the tungsten lamp was relatively wasting less energy in heat than a gas-lamp, because one could feel the heat with a gas-lamp but not with the electric lamp. Fifteen years ago, in the old carbon lamp days, it would have paid better to put gas at 2s. 10d. per 1000 cubic feet into an engine and electrically light a house than it did to send it straight to the burners and use it there. The efficiency of gas-mantles had gone up, relatively to the old burners, from four to five times; and the tungsten lamp had improved to the same extent as compared with the old high-voltage carbon lamp. Therefore the fact, which was never denied by gas engineers, that one could put gas into an engine and electrically light a place cheaper than by sending the gas straight to the burner, still held good; and it was brought out in Mr. Thorp's paper. If they worked some of his figures backwards, giving 50 candles per cubic foot and 5 candles per watt, they would find the results very close indeed. Mr. Newbigging had asked for information in regard to the five lamps costing £50. Of course, he meant lamps for use in a factory, and not in the streets. He could name several large workshops where they were using a lamp which cost three guineas, and, so far as its light-giving quality was concerned, it was as good as could be had for £9. Reference had been made to the flourishing condition of gas companies. But they were in existence for many years without competition, and had piled up large reserves. He was glad to say the big electricity companies were getting into a similar position; and when they had been established as long as the gas companies, they would be on quite as sound a foundation.

Mr. Evered said they had heard a great deal about oil being entirely "out of it;" but, fortunately, the gentlemen who made these remarks admitted that they knew little about it. He might take it, therefore, that they were thinking of the old wick lamp that burnt oil and was very costly. Since the gas-mantle had come in, they had been able to use it with a vapour of oil which yielded something like 22 times more light than the old wick lamp gave with the same quantity of oil. In one of the shops he had shown on the screen, they used, previous to the introduction of the oil-gas lighting, nothing but electric lamps; and the change was made on account of the glare from them. This was more than two years ago; and the oil installation had given every satisfaction. Mr. Newbigging had remarked that the cost of oil was going up, and was now at 8d. a gallon. It certainly was higher now, on account of the shortage of vessels to carry it; but to-day they could book contracts for the delivery of oil twelve months ahead cheaper than it could be bought for at present. This showed that, if vessels could be secured, they could get it as cheap as they did twelve months ago—viz., 4d. a gallon. In conclusion, Mr. Evered observed that he had purposely avoided any allusion to other systems, and had tried to keep away from controversy of any kind, because he firmly believed that the world was quite large enough, in the engineering line, to provide business for all of them.

ECONOMIC AND HYGIENIC VALUE OF GOOD ILLUMINATION.

There was a large attendance at the meeting of the Royal Society of Arts last Wednesday, when Mr. Leon Gaster read a paper on the "Economic and Hygienic Value of Good Illumination." The chair was taken by Sir Arthur Whitelegge, K.C.B., M.D., F.R.C.P., Chief Inspector of Factories of the Home Office. In view of the recent appointment of the Lighting of Factories Committee, of which Sir Arthur and Mr. Gaster are members, additional interest attached to the proceedings.

The paper was of considerable length; and the author had to curtail it somewhat in order to compress it into the available time. In opening, he referred to the strides that have been made since 1909 in the practical utilization of light; and he claimed for the Illuminating Engineering Society that it had done much to foster interest in the subject. He also acknowledged the sympathetic interest and help of the Royal Society of Arts. There was also comment on the social influence of light, in the matters of promoting safety of the public in streets, cleanliness in homes, comfort in travelling, and adding to the facilities of education, business, and recreation. There was history in the paper, and a presentment of matters that are of our everyday life. Then, in due time, we arrived at the more practical part of the communication, in which the author dilated on the value of good lighting: (*a*) As a hygienic necessity; (*b*) as a means of preventing accidents; and (*c*) as desirable on purely economic grounds. He advised that the best methods of using the new lamps on the markets should be studied. It is not enough to get *more* light; one should also get *better* light.

Protect the Eyes of the Young.

Dealing with the hygienic aspect, the evidence accumulates as to the prejudicial effects of poor lighting. The efforts made to ensure that the lighting of schoolrooms should be kept up to a good standard may be nullified if the child is allowed to ruin its eyes at home. The reports on the eyesight of children in schools have given great concern to the medical faculty. In 1905, the "British Medical Journal," in an article entitled "Eyestrain and Brainstrain," referred to researches in various schools in this country, and showed that, in the case of nearly half those visited, the lighting was deficient. In the same way Dr. Bondi, in Germany, has given actual data showing how the percentage of children having defective vision increased during school life between the ages of eight and nineteen. Thus, in the Realschule 22 per cent. of the children in the Upper School had defective vision, but only half this number in the Lower School. In the Gymnasium, on the other hand, actually 31·5 per cent. of the elder pupils were short-sighted. In New York, in 1902, of 58,948 children examined, 17,938, or 30 per cent., suffered from bad sight; while, according to some figures quoted by Professor W. D. Scott, and obtained by the United States Bureau in 1881, in certain classes a percentage as high as 70 was actually reached. Now these last figures were obtained some time ago, and fortunately the conditions that tend to produce bad sight are now being more closely studied. Yet recent returns show that the percentage of children suffering from defective vision, even to-day, is often very considerable. Dr. Hope, of Liverpool, last year, stated, in a report, that he traces a definite relation between the lighting of schools and

the number of short-sighted children attending. Dr. James Kern, Medical Officer to the London County Council, has also pointed out that to a growing child good illumination is even more essential than to an adult. There was reference to the information contained in Dr. Kern's paper before the Illuminating Engineering Society in 1911 [as reported in the first volume of the "JOURNAL" for that year]. Emphasis was also laid upon the importance of the avoidance of inconvenient shadows and glare in school-rooms. In the schools of London, there are upwards of a million children. Arrangements are made for the eyesight of the children to be constantly tested, and for glasses to be provided where necessary. But the author urged that the lighting of the schools should be investigated at the same time. Passing on, he pointed out as an obvious fact that grown-up people are likewise affected by insufficient light. It is impossible for a man, whatever his avocation, to do his work satisfactorily if he cannot see what he is doing.

GLARE.

Then we got on to glare; and the classical figures of Stockhausen were quoted as to intrinsic brilliancy of various sources of light, expressed in candle power per square inch of radiating surface, which show how considerably lower is the intrinsic brilliancy of the mantle than of our form of electric light. The most brilliant modern lamps have a dazzling effect on the eye when injudiciously used. Some authorities suggest that all sources of light should be screened-down so that the intrinsic brilliancy does not exceed that of the sky (estimated at about 3-candle power per square inch). It is generally regarded as a good principle that the light should be concentrated on the work, and that illumination should be screened in such a way as to prevent the direct rays from bright filaments and mantles striking the eye, and that in any case such lights should not be placed in the direct range of vision. It is possible that repeated exposure to a very brilliant source at close quarters may permanently injure the eye.

ACCIDENTS AND LIGHT.

The author turned attention to the influence of illumination in industry. The effect upon the eye of excessively brilliant illumination was again introduced; and in this matter the employer is not without his responsibility. Poor illumination leads to accidents, to inferior work, and to low output. In places where dangerous machinery is used, good illumination is particularly important; and in all occupations involving danger of any description, this holds good. Ill-lighted passages and steps should be particularly guarded by light. Incidentally there was a reference to street accidents. Up to a certain point the increase in the illumination of our streets has been beneficial; but the question has arisen whether the multiplication of very bright sources of light, with their dazzling effect on drivers and pedestrians, is not sometimes responsible for accidents; and whether some form of screen, capable of directing the light on to the roadway, and screening the direct rays from the eyes of people in the street, might not be insisted upon. An accident recently occurred in Hanover Square; and, in connection with it, it was stated that the glare of the bright lights in adjacent streets made it difficult for drivers to see when they passed in to the comparative obscurity on either side. The use of high-power lights outside shops was condemned as inconvenient to people passing along the pavement [the degree of inconvenience has some relation to the character of the high-power light].

ECONOMIC CONSIDERATIONS.

Returning to factories, good illumination is conducive to the keeping of machinery in proper order. That is an economical question. "Adequate" illumination pays the employer all along the line. An accident or breakdown of machinery results in disorganization; and many breakdowns are traceable to bad illumination. Then there followed further comment urging the case of good illumination from the standpoint of quality of work and increased output. The employer has every reason to welcome good illumination, and has "little" [would not "nothing" be a better term?] to gain by grudging the small initial expense sometimes necessary to put things on a proper footing. The total cost of lighting is but a small fraction of the total wages bill; and the saving of time through using good light will pay the cost of the improvement.

A short time ago, an inquiry was addressed by the National Electric Lamp Association to a large number of industrial concerns in the United States. Out of 209 replies, 164 mentioned that improvements had been recently made in their lighting; and a number of expressions of opinion were received to the effect that increased production, better-class goods, and greater satisfaction on the part of the workers had been the result. Summarizing these 164 cases, it was found that 28 per cent. said that the lighting costs had been reduced; 19 per cent. said that their output was increased; 37 per cent. said the workers were better satisfied; 13 per cent. said that the change was too recent to give figures; 64 per cent. said in general terms that they were satisfied that the change was well worth its cost; and less than 5 per cent. said they had traced no direct benefit as yet. It need not be assumed that an improvement in lighting necessarily means increased expense. In many cases, the weakness is not that too little light is provided, but that the light is not wisely used. A slight rearrangement of the lamps, the substitution of improved forms of reflectors, and an intelligent appreciation as to how the light should be distributed in order to suit the work, will effect all that is required. Here reference was made to the report by Mr. D. R. Wilson on illumination in factories which was noticed in the "JOURNAL" last July.

WHAT IS MEANT BY ADEQUATE ILLUMINATION?

The question may perhaps be asked what is exactly meant by adequate illumination? The problem is one that the Illuminating Engineering Society have been studying for some years, and do not as yet feel confident to return a complete answer. But as an illustration of some fundamental points in good lighting which should meet with general agreement among those who have studied the subject, the author quoted the following simple recommendations, taken from "Light and Illumination: their Use and Misuse [see "JOURNAL" Nov. 26 last]: (1) "Don't work in a flickering light. (2) Don't expose the eyes to unshaded lights in the direct range of vision. (3) Don't judge illumination by the brightness of the lamps. (4) Avoid excessive contrasts. (5) Use the right type of globe, shade, or reflector. (6) Make sure that the illumination is sufficient. (7) Keep lamps, globes, and reflectors clean. (8) Make sure that lamps are in a right position." In Mr. Wilson's report, the main essentials of good lighting are summed up as follows: (1) The illumination must be adequate; (2) Glare effects must be absent; (3) No troublesome shadows must be cast on the work. These recommendations are intended mainly for industrial lighting; but they also have a wider application. It is not enough to ensure that the light in a room is powerful. It is much more essential that the light should be wisely used, and that the illumination should be sufficient at the exact spot where the work is carried on. The motto should be "Light on the object, not in the eyes."

MEASUREMENTS OF ILLUMINATION.

There succeeded some observations on shades and reflectors; and then the author dwelt on a favourite subject—the measurement of illumination. He held that the amount of light required in factories needs full investigation, as the conditions vary so considerably. Disagreement on this point exists among manufacturing concerns. As an illustration, figures given by Mr. F. W. Goodenough in a recent paper were quoted. In the case of six different printing works, he found the values of illumination ranged from 3·4 to 26·8 foot-candles. Mr. Wilson, in his report, gives the following figures for printing, cotton factories, &c.:

	Foot-Candles.
Clothing (machine room)	2 to 36
Handkerchiefs „	2 to 8
Composing-rooms	3 to 30
Cotton weaving	1 to 5
Linen weaving	3 to 18

while in cotton spinning and preparing rooms much lower values, ranging from 0·01 foot-candle to 6 foot-candles, were encountered. In the course of his report, Mr. Wilson gives the results of more than 2500 measurements in over 125 factories; both daylight and artificial light being studied.

OFFICIAL RECOGNITION—LIGHTING OF FACTORIES COMMITTEE.

How the question of official appreciation of the importance of factory lighting is growing, is shown in the next portion of the paper. In the report of the Departmental Committee on Accidents in Factories, it was recommended that a general statutory power should be given to inspectors to demand adequate lighting. In the Indian Factory Act of 1911, inspectors are empowered to serve on the manager of a factory an order in writing specifying the measures which he considers necessary for the attainment of a sufficiently high standard of lighting, and requiring him to carry them out before a specified date. The author suggested that, with a view to avoiding misunderstandings, recommendations of this kind should be supported by fuller instructions as to what constitutes good lighting. What has been done in Holland and in connection with congresses received notice; and then there was allusion to the appointment of a Special Committee by the French Government to study the hygienic aspects of illumination. The Belgian Government have also been approached in reference to the matter; and the New York Factory Commission (as was recently shown in the "JOURNAL") have a draft Bill under consideration which will require good illumination in all factories. Finally, it is gratifying to be able to record that, thanks to the untiring efforts of Sir Arthur Whitelegge, a Committee, charged with the investigation of industrial illumination, has been appointed by the Home Secretary in this country. On this Committee the author casually stated that he has the honour of serving. At the present moment he could not discuss the programme of the Committee, nor express any opinion as to the comparative hygienic or economic advantages of various systems of illumination. The great possibilities of useful work to be done cannot be gainsaid.

DISCUSSION.

The CHAIRMAN (as did many other speakers) referred to the admirable character of the paper. Proceeding, he said that an ample case had been made out for adequate lighting; and that consequently they needed to know what was "adequate lighting," and to ascertain what were the conditions that made for adequacy. The author had spoken with admirable reticence as to the labours of the Lighting of Factories Committee, and which labours were about to begin. The Committee, he (Sir Arthur) was sure, had a big task before them; but they had the advantage

of being early in the field. He appreciated the author's reference to the work of his (the Chairman's) own department of the Home Office, and to the admirable investigation made by Mr. Wilson. This was pioneer work so far as it went. It showed the complexity of the subject of illumination, and the necessity of a clear-headed way of approaching the matter. When they had settled some of the problems surrounding the question, then perhaps Mr. Gaster's Utopian idea of an International Conference might be realized; but at the moment they were concerned with the humble task of beginning the study of this question.

Mr. F. W. GOODENOUGH hoped that the lay Press, as well as the technical Press, would give prominence to the points Mr. Gaster had brought forward, because it seemed to him the paper had its greatest value in its educative possibilities. What was wanted was to educate the users of light into realizing the necessity for adequate illumination; and while they were realizing this necessity, perhaps it would be well for the suppliers of illuminating agents to set to work to realize what they had to provide the users with when they asked for adequate illumination. While inquiry was going on in this direction, it was to be hoped that public opinion would be stirred, so that the desire for adequate illumination would be stimulated.

Mr. FRANK BAILEY (City of London Electric Supply Company) remarked that allusion had been made in connection with this subject to the difficulties of standardizing, and of being in the position to refer users to precise measurements. It seemed to him they could not do better than realize the standard to which they ought to attain; and there was fortunately a good example in the sun. In modern lamps, they had powerful weapons. For instance, if the filament of the tungsten filament lamp were placed too close to the eyes, it might be a very serious matter. In his opinion, the subject of the screening and diffusing of light was alone worthy the whole efforts of the Society of Illuminating Engineers. There was a large amount of work to be done in producing admirable illumination and good effects by simple means. Regarding street lighting, they must realize—especially now that there was such fast moving traffic—that the desirability of getting about in safety was becoming a more acute question. It was much better to avoid being run over than to suffer from bad lighting.

Sir HENRY TRUEMAN WOOD made an interesting statement as to the lighting of the lecture theatre of the Royal Society of Arts during the past 140 years. When the room was first built, it was lighted by four oil-lamps. There were three or four lamps to each pendant. A gas lamplighter was paid 4½d. per lamp per meeting for cleaning and supplying with oil. There was a good deal of difficulty with this man; and eventually the price was raised to 6d. per lamp. This went on for quite a long time. About the middle of last century, there were some experiments in lighting in the room; but it was not until 1854 that it was determined to remove the old oil-lamp pendants, and replace them by gas. He could not quite make out whether this was done; but a gas sunlight lamp was subsequently put in where the present sunlight lamp was now. This was continued until 1882, when the electric light was introduced. He believed that this was the oldest installation of electric light in London in a public place. Sir William Crookes had introduced the light into his own house in Kensington about a year before. The current was generated by an "Otto" gas-engine and a Siemens machine, and for a short time they had in use an "E.P.S." storage battery. This plant went on until 1889; and then current was taken from the street mains. The first introduction of gas by the Society was in 1815, when a gas-lamp was placed at the entrance in the street. Gas at that time was not regarded as fit for indoor illumination, as the purification was so imperfect. Between 1830 and 1840, gas lights were placed on the stairs; and then gradually it made its way to other parts of the house. But it was not introduced in the lecture-room until about 1850. [Incandescent gas lights are used in the building, but not in the lecture theatre.]

Mr. D. R. WILSON (Home Office Factory Department) thanked the author for his complimentary references to the investigation he had made of illumination in factories. In spite of the number of measurements he had carried out, the impression left on his mind, as the result of the investigation, was that this was only the fringe of the question. It was a subject of the greatest complexity; and he felt that the Committee who had been appointed had a difficult and long task before them in getting to the bottom of their reference. It had always struck him as being rather anomalous that, in the Factory Acts, the workers' bodies were well looked after, but that most important organ, the eye, was neglected. His hope was that in a few years' time, when the Committee had reported, this matter would be embodied in legislation, so that the workers' eyes might be protected as well as other parts of their bodies.

Mr. C. C. PATERSON (National Physical Laboratory) remarked that the thorough way in which the author of the paper had pushed the subject of illumination had caused everybody to be talking about it. If the work had not done this, then they would have been more behind the times than they were now. The work that had been accomplished was not anything compared with what would be done; and he fully hoped that great things would follow from the labours of the Lighting of Factories Committee.

Mr. F. W. WILLCOX remarked that new illuminants had created new conditions, which required much closer attention and consideration. He did not know whether or not there was something peculiar about the climate of England; but it was a fact, from the observations he had made, that the methods of lighting adopted here were not greater in improvement than in any other country with which he was familiar. The cost to the people of Great Britain, in home, shop, factory, and other lighting—as the result of impaired vision, loss of output in manufacture, and excessive cost of lighting—must run into tens of millions a year; so that they were faced with an economic question. The cost of the investigation that was going to be held would be in the result paid for over and over again.

Dr. W. ETTLES hoped, in connection with the inquiry that was about to be made, that due attention would be given to the quality of light, as well as to the quantity. There was a great deal in this, because their eyes were spectroscopes, and they had a large amount of chromatic aberration; so that quality of the light affected the power of perception. If they took an eye-test chart, it would be found that with blue light one could only read about half way down the print; but if one eliminated the blue with red light, one could read the whole of the print. The red light was fixed on the retina, but the blue light was fixed in front of the retina; so that they were relatively short-sighted to blue illumination. White light contained both red and blue rays; and he had found on many occasions that people could see better, if the extreme blue rays were cut off by means of a pale yellow screen. In testing visual acuity, he always used a pale yellow screen; and the increase in visual acuity was very perceptible. A practical point which might well be considered was whether, where electric lamps were used for factory lighting, the bulbs could not be made of a glass which would filter out the extreme violet end of the spectrum, and whether this would not increase the comfort of the workers. Another point which occurred to him affected the man working with a pool of light shed upon his work; his own vision and his surroundings being in darkness. *Primâ facie*, this struck one as being ideal illumination; but, in actual work, it was by no means ideal. Working in this way the eye became light-adapted, and the surroundings became darker by comparison. This could be overcome by having a small amount of general and satisfactory illumination. In other words, the pool of light he regarded as a strain upon the eyes. There was another matter over which he thought a great deal of good could be done for the workers in factories. Many working people did not care to confess to their employers, and they hardly cared to confess to themselves, that, when September came, and the days began to draw in, they found infirmities commenced to creep upon them. These workers feared to have their defects recognized by their employers, lest they should get discharged. But by the simple process of increasing the illumination, they would be adding to the comfort of these people, and adding to the efficiency of their work. The qualitative investigation of light was one which must not be lost sight of.

Mr. T. E. RITCHIE spoke on the subject of the economic value of illumination; and Mr. R. J. WALLIS-JONES hoped that they would soon find out what "adequate" illumination meant. It was of great importance that manufacturers and other people should be educated upon this question.

Mr. GASTER (the usual time of the meeting having been about exhausted) touched, in reply, on a few of the points raised in the discussion. Among his remarks, he agreed with Dr. Ettles as to the quality of light being of great importance. Of course, there were certain colours that acted differently upon different people. The question as to the spectrum composition of light was of great consequence. No doubt, too, some part of the rays from the light had a sterilizing effect. He agreed that strong contrasts of light were undesirable; it was quite impossible, passing from a strong light into a poor one, to quickly get the requisite adaptation. It surprised him to see people compelled to work under high-power arc lamps. As to the work of the Lighting of Factories Committee, there would be one difficulty, and that would be in obtaining tests of the eyes of the workers themselves. He quoted a phrase that has a familiar ring about it: "Let us learn from the evils of the past, in order to improve the future." Concluding his remarks, he said that what they were all working for was good light, good output, greater economy, and better health for the workers engaged.

Manchester District Institution of Gas Engineers.—We learn from the Hon. Secretary (Mr. W. Whatmough, of Heywood) that the annual meeting of the Institution will be held on Saturday, the 22nd inst., when, in addition to the address of the President (Mr. J. C. Belton, of Chester), there will be a paper by Mr. James Lomax, of Bolton. A recommendation by the Committee to make a grant of £10 10s. to the Benevolent Fund of the Institution of Gas Engineers, £5 5s. to the British Commercial Gas Association, and a similar amount for the National Gas Exhibition, will come up for confirmation.

Gas-Heated Bakers' Ovens in Paris.—In the course of the speech of M. Dausset, in the Paris Municipal Council, when introducing the budget in connection with the gas undertaking for the current year, he referred to the extended use of gas for heating bakers' ovens. This method of utilizing gas was, he said, unknown two years ago; and the Gas Company had some difficulty in securing two or three bakers in the city to adopt it. Last year, however, there were nearly thirty who employed gas for heating about forty ovens. Under the auspices of the Bakers' Syndicate, some comparative experiments were made in the spring, under official supervision, and the results were very conclusive.

GAS-ENGINE RESEARCH.

Professor Hopkinson's Second Lecture.

The second lecture on "Recent Research on the Gas-Engine" was delivered last Thursday afternoon, by Professor B. Hopkinson, M.A., F.R.S., of Cambridge University, at the Royal Institution, Albemarle Street, W. Some account of the first lecture, which was delivered the previous Thursday, will be found in last week's "JOURNAL," p. 310.

On resuming the discussion of his subject, the lecturer explained briefly the process of discharging and reloading of a gas-engine cylinder; remarking that the time available for the reloading operation is very short, though it varies in different engines and with the speed of running. During this short period, the whole cylinder has to be filled with the next charge; and it is therefore necessary for the gas to come in at a very high speed. The average speed at which the gas enters during the time of suction may be taken as 120 miles an hour; but when the piston is moving at its highest speed, a figure as high as 180 miles an hour may be reached. As the result of this rapid inrush, the contents of the cylinder are thrown into a violent state of eddying motion. This motion continues during the time of compression; and there must still be motion in the gas when the compression is completed and the charge is about to be fired. It had long been supposed that this turbulence did exist; but the importance of it in connection with the working of the gas-engine has only recently been discovered. The question of this turbulence was really first raised in connection with the heat-flow problems which formed the subject of the first lecture.

EFFECT OF TURBULENT MOTION.

Take, said Professor Hopkinson, an engine running at its proper speed, and giving (say) one explosion per second; and then the same engine working at half this speed. After each explosion the cylinder will be filled with flame; and in the latter case this flame would be in contact with the walls just twice as long as under the first-named conditions. It might therefore be expected that the flame would, at each explosion, part with twice as much heat to the walls as it did when the engine was running at the higher speed. If this were so, instead of losing 30 per cent. of the heat, 60 per cent. would be lost, and the total heat carried away by the cooling water per minute would be the same as at the higher speed. This expectation, which left out of account the effect of turbulent motion, was, however, he remarked, found not to be in accordance with the facts. Instead of the slow-moving engine parting with twice as much heat per explosion, it was discovered that the amount was roughly the same. There was some increase, but not much. When the turbulent motion of the gas is taken into account, this is explained. It is well known that gas in motion takes up heat or parts with it much more rapidly than does a still gas. The cylinder of a gas-engine is a very draughty place; and the faster the engine runs, the more draughty it is. With an increase in the speed of the engine, the rate at which the gases rush in must be increased; and the time elapsing between the shutting of the valve and the ignition—during which the turbulence can die away—is less with the fast engine than with the slow-running one. These considerations of turbulence, therefore, offer a plausible explanation of the fact that the faster-running engine gives about off the same amount of heat per explosion as the slow-running engine, whereas, with no motion, one would expect it would give up only half as much.

This subject, explained the lecturer, was taken up two or three years ago by the members of the British Association Committee; and an experimental investigation was made to elucidate it. The object was to prove that the turbulent motion does exist throughout the compression stroke of the engine; and the method employed was to make use of the knowledge that a moving gas loses heat or takes in heat more rapidly than a gas at rest. A loop of platinum wire was placed by him in the clearance space left when the piston was in the cylinder; and to prevent the wire from melting from the heat of the explosion, the engine was not allowed to work in the ordinary way, but was turned round by an electric motor, and prevented from firing. The temperature of the wire was measured at the moment of the top of the compression, first without any—or very little—current traversing it, and then after an electric current had been made to traverse it and heat it. It was found that the rise in temperature produced by this current at a certain point was much less than in still air—only one-half as much, in fact. This proved that the air must have still been in motion at the conclusion of the compression. Further, it was found that, when the engine was motored round at different speeds, the effect became less as the speed was reduced. Thus two points were established—first the existence of the turbulent motion, and, secondly, that it diminished about in proportion to the speed of the engine. The experiments showed, not only that the motion existed, but that it was sufficient to materially affect the rate at which the gas took in, or parted with, heat. They were, however, not so much interested in what happened before the gas was fired as in what took place afterwards. They wanted to prove that the flame, in consequence of its motion, parts with its heat at a much greater rate than if there was no motion. To settle this question, another experiment was tried. A closed vessel, fitted with a fan, was filled with a mixture of gas and air, and then the fan was revolved to set the charge in motion. The vessel was lined with copper strip; and means were taken whereby the temperature of the copper strip, following the explosion of the gaseous mixture in the closed vessel, was recorded. At the same time the pressure resulting from the explosion was also recorded. It was found that when the fan was moving, the pressure jumped up much more rapidly than when it was still; and the other point was that the copper also heated up much more rapidly. With the same temperature of the flame in the cylinder, they got a much more rapid flow of heat when the gas was in motion than when it was at rest. This effect, said Professor Hopkinson, must, of course, exist to a considerable extent in the gas-engine. Where the flame is in motion, one will get a much more rapid flow of heat than when it is at rest; and the faster the engine runs, the more rapid will this flow of heat be. The investigation referred to therefore established the point as far as the flow of heat is concerned.

TURBULENCE AND VELOCITY OF IGNITION.

In a gas-engine or closed vessel, he continued, the thing that ensures the flame is a spark passing at one particular point; and the result is to fire the gas in its immediate neighbourhood. This spark disappears; and the little bit of burning gas ignites in its turn the gaseous mixture in contact with it, and so the flame spreads through the whole mixture. At the same time, the pressure in the cylinder of the engine or in the closed vessel rises, and reaches its maximum when the flame is completely through the mixture. [The means adopted for proving this were demonstrated.] In a closed vessel, where the gas is at rest, this spread of flame is comparatively slow. With a strong mixture, the flame takes about 1-20th of a second to fill the vessel. When the mixture is diluted, the process is a much slower one, and to reach the maximum pressure may take about a quarter of a second. By firing a mixture in a closed vessel with a glass window, the lecturer showed the audience the truth of this; and he then pointed out that the weak mixture was what is generally used in gas-engines. The time available for this flame propagation in a gas-engine is, however, very much less. It depends, of course, upon the speed at which the engine is running; and in a large engine it might be as much as 1-20th of a second. But this must be a very large engine. In the smallest ones (motor-car engines, for example), the propagation must be completed in as short a time as 1-200th of a second. In a 12-inch cylinder gas-engine, it is something like 1-100th of a second. Were it not for the existence of this turbulence, therefore, it would be impracticable to work a gas-engine at any speed, and a motor-car engine would be impossible. To illustrate what he had said, a fan was set in motion inside the closed vessel, which was filled with a precisely similar mixture to that used before; and when the charge was fired, the spread of the flame was seen to be very rapid. This, went on the Professor, brings home to us the great importance in the matter of the gas-engine of this turbulence. The fact that ignition must take place much more rapidly in a gas-engine cylinder than in a closed vessel has been known for a long time; but its cause has been always somewhat mysterious. It was formerly thought to be due to the fact that the charge is compressed; but experiment has shown that this is not sufficient to account for it. The mystery has, however, now been solved in the way described.

Remarking that the discovery of the great practical effect of this turbulence is due to Dr. Dugald Clerk, the lecturer proceeded to describe the very ingenious experiment by which that gentleman has shown its existence and effect. Taking a four-cycle gas-engine, he fitted it with appliances whereby he could throw out of gear at any moment the sparking arrangement and also the gear by which the valves were lifted, so that as soon as he made use of this mechanism the cylinder remained closed and the charge ceased to fire. The mixture would then simply be compressed and expanded. He worked the engine in the ordinary way until the moment when it had just taken in a charge of gas and air and was about to compress it. Then he threw out of gear the ignition, and stopped the action of the valves. Of course, the charge of gas and air taken in by the engine was in turbulent motion, just as if the engine had been working in the ordinary way, as it had been doing until the charge was trapped; but the charge was expanded and compressed for one or two revolutions, until there had been time for the turbulent motion to die away. When this motion had ceased, he threw in the ignition again, and fired the charge—taking an indicator diagram, showing the complete succession of operations, and illustrating in a very convincing way the actual effect of this turbulent motion. Two of the diagrams were shown; and these were the same as were reproduced in the "JOURNAL" for Sept. 10 last (p. 691), from the fifth report of the British Association Committee. The demonstration of the whole thing might, Professor Hopkinson said, now be considered as complete. There is a providential connection between the amount of turbulence and the speed of the engine. At very high speeds there is extremely little time for the flame to flash through the space. But it is just at this high speed that there is a big amount of turbulence; and if the speed is lowered, the turbulence diminishes. This state of things had been in existence for about thirty years without anyone suspecting it.

DIFFICULTIES AND A PROPOSED REMEDY.

Drawing towards the close of his discourse, the Professor remarked that the chief theme of these lectures had been the difficulties in the operating of gas-engines which arise from the fact

that, during a large part of the working stroke, the cylinder is filled with flame, and in consequence heat flows at a great rate into the walls. He had shown that it is necessary to provide water circulation round the cylinder, and, with large engines, in the moving piston itself. He had dealt with the great complication of construction necessitated by this fact, and pointed out that even with this water circulation, the problem is not completely solved, because the heat has to get from the inside to the outside of the metal, and difficulties arise from unequal expansion and pre-ignition. The scientific study of the question of heat flow is, he continued, quite recent; but designers of engines have come to appreciate it completely, and it has left its mark on design in many ways. The most obvious method of dealing with this question of heat flow is to diminish its actual amount, by using weak mixtures; but this method of tackling the problem is not, of course, satisfactory, because it means that the engine gives less power. It is therefore really only a makeshift; but the plan has to be adopted in large gas-engines, because it is found that if mixtures of more than a certain strength are used, the flame is so hot that the cylinder is apt to crack. In fact, the difficulties become insuperable. Since the matter has come to be better understood, design has improved very much in the direction of providing better means for the gas to get away. That is, means have been furnished whereby the heat can be conducted better from the place where it is generated to the place where it is removed—namely, the water.

A section of a modern design of "National" gas-engine having been thrown on the screen to illustrate this, the Professor said that, after all, it did not seem to him, at any rate, that the plan so far adopted is the right way of tackling this problem. The heat gets into the metal inside, and in all engines hitherto built has been removed on the outside. It would appear that the rational way is to apply the cooling medium, not to the outside of the metal, but directly to the place where the heat goes in to it. He stated that he himself had attacked this problem, and had had an engine made, in which the question of heat flow is dealt with in this manner. An illustration of the idea was given to the audience by means of a slide of a section of the combustion chamber and piston of a 50 B.H.P. jacketless engine, fitted with water injection. There is passed into the combustion chamber a rose drilled with small holes, from which jets of water are projected on the metal inside. The idea of injecting water, he explained, is quite an old one; but it has never hitherto worked successfully, for several reasons. Further, he did not think that it has been applied with a knowledge of what this heat flow really means. Dealing with his own arrangement, he pointed out that the heat is such that every drop of water is boiled as soon as it reaches the cylinder walls; and it is this boiling of the water which takes away the heat. In order to provide against difficulties of corrosion, and so on, the water is only sprayed on to the head of the piston, the surface of the combustion chamber, and the exhaust-valve. The supply of water is taken in during the time of expansion, so that it is entirely prevented from falling on the sliding portions of the engine. An engine on this system has been at work for a considerable time in Cambridge; and a large one is now being built in which he trusts the whole thing will be worked out. Indeed, he is not without hope that on these lines it may be possible to accelerate, at any rate, the development of the gas-engine in large sizes. That is to say, that by the use of internal water injection it may be possible to do away with some of the existing complications.

Illuminating Engineering Society of Germany.

We learn from the "Journal für Gasbeleuchtung" that the Committee of the newly-formed Illuminating Engineering Society of Germany has issued a circular letter urging interested parties to become members. The corresponding Societies of England and America are quoted to show the advantages of having such a central organization to consider questions of lighting and to uphold the interests of the nation, to effect improvements, and to elicit help, where possible, from those who are indirectly interested in artificial lighting—such as architects, hygienists, and oculists. It is the best means of avoiding undue and unwholesome competition among the various systems of lighting, and the whole science, both theoretically and practically, needs much more care and attention than it receives at present. The first general meeting of members is to be held on Feb. 24, and the business will be conducted by a Committee, under the presidency of Professor Dr. E. Warburg, which contains many names very well known in the gas profession in Germany.

The Royal Experimental Institute in Vienna intends compiling a list of all technical experimental institutes both at home and abroad. The following data and particulars are desired: The special branch of technical work done; address of the institute; names of the proprietors and the officials; information as to whether independent or connected with any school, university, association, or industry; whether for general use or private purposes only; and, finally, some details as to equipment and working capacity. All technical experimental institutes, with the exception of those already in communication with the one at Vienna, are invited to send such details as soon as possible to the President, Herr k.u.k. Wirklicher Geheimer Rat Exner, K. K. Technisches Versuchsamt, Michelbeuerngasse, 6, Vienna.

SCOTTISH JUNIOR GAS ASSOCIATION.

EASTERN DISTRICT.

The Quarterly Meeting of the Eastern District Division of the Scottish Junior Gas Association was held on Saturday in Dundee. Mr. A. Bishop (Newtongrange) presided over an attendance of between forty and fifty members.

Construction of a Gasholder in a Ferro-Concrete Tank.

Mr. G. P. Mitchell (Dundee) read the first paper, entitled "Notes on the Construction of a Gasholder in a Ferro-Concrete Tank." It will be found, with a report of the discussion upon it, on p. 393.

Every-Day Experiences in Gas Distribution.

The second paper, which was entitled "Every-Day Experiences in Gas Distribution," was prepared by Mr. John Ferguson, of Forfar, who, owing to illness, could not be present. The paper will be found on p. 397.

THE DUNDEE GAS-WORKS.

Mr. Alex. Yuill subsequently gave a lecture, illustrated by lantern pictures, on the Dundee Gas-Works. He mentioned that they had 600 retorts. This year the sales had increased over 40 million cubic feet; and as there were still three months to go, he believed the increase for the year would be over 50 millions. They used water-tube condensers, which they found very effective. In proof of this, he showed comparative records taken with and without the condensers. All the coal as it passed into the works, he continued, was weighed in the waggon, and then, after it was emptied, the waggon was weighed, so that they made sure they paid for only the exact amount of coal which went to the steelyard. Showing a photograph of the retort-bench, Mr. Yuill pointed out that twelve were set in each oven. He remembered some time ago a debate took place as to whether it was possible to heat two retorts with one fire. He wondered what the speakers then would say now if they were aware that there was no difficulty with the heating of twelve retorts. Mr. Yuill recalled an experiment made to see whether it was possible to heat the whole twelve through retorts, 20 feet long, with one fire. The experiment not only succeeded, but it gave them equal heat from top to bottom. They also made the interesting discovery that it took practically double the coal to heat the through retorts; so that there was no saving. Had there been a saving of (say) 15 per cent., they might have been encouraged to proceed with the idea.

A photograph of the two exhausters led Mr. Yuill to explain that formerly they were fitted with a bye-pass. If one put one's ear to the bye-pass, a whistling sound was heard. They had now dispensed with the bye-pass, and instead had a little governor so sensitive in its working that they were able on their records to get almost straight lines. Two comparative records made with the bye-pass and the governor respectively, illustrated the remarkable regularity induced by the governor.

Pictures of the exhauster-house, scrubbers, and washers were next shown by Mr. Yuill, who explained that they found that their present scrubbers worked too slow. They were speeding-up these machines to about three times their present rate. Having shown views of the oil-storage plant and the 30-H.P. turbine, he presented pictures of the gasholders. Parenthetically, he remarked that their trouble was not a case of insufficient holder capacity, but that the holders they had were not able to give them sufficient pressure to meet the maximum consumption. The well-equipped repairing shop, of which a picture was also shown, drew from Mr. Yuill the remark that their own workmen did all kinds of repairs, and in the works they had machinery for almost every kind of job, with very few exceptions.

Visit to Broughty Ferry—Automatic Lighting.

Several members availed themselves of the invitation extended to them to visit the Dundee and Broughty Ferry Gas-Works. At the latter place they had an opportunity of inspecting the automatic lighting system which has been introduced under the superintendence of the Engineer and Manager Mr. George Keillor, who described it at the last meeting of the North British Association. It is on the "A. & M." pressure-wave system, and since its introduction it has given very satisfactory results. In the burgh there are 651 lamps, and the lighting and extinguishing pressure is produced by means of an electrically driven fan. The first wave lights all the lamps, the second extinguishes the evening lamps, and the third the morning lamps at dawn. By means of a perfected system of inspection, the slightest fault is traced in any part of the lighting area. After the application of each wave, inspectors on bicycles make a tour of the entire district, and if, through some defect, one or two lamps have failed to respond to the pressure wave, the trouble is at once noticed. This elaborate inspection has not been introduced because of any weakness of the pressure-wave system, but to ensure efficient street lighting.

The visitors were specially interested in the governor-room, where are installed the automatic electric starter and the motor fan and pressure-recorder. Since its introduction some months ago the controller has given perfect satisfaction, and the only failures have been due to such minor occurrences as a bye-pass being broken, or a lamp mischievously smashed.

The system, too, has proved economical, and on wages alone the concern is saving something like £110 per annum.

The whole of the works were in excellent order, and the visitors had an opportunity of seeing in operation West's manual charging machinery, as worked in probably the smallest gas-works in the country which have machine charging.

NOTES ON THE CONSTRUCTION OF A GASHOLDER IN A FERRO-CONCRETE TANK.

By G. P. MITCHELL, of Dundee.

[A Paper read before the Scottish Junior Gas Association (Eastern District) on Feb. 8.]

In this communication, I purpose to deal simply with the work carried out in increasing the gasholder storage at the Alloa Gas-Works, by utilizing a brick-built tank containing a single-lift holder of a capacity of 75,000 cubic feet—increasing the depth of the tank by constructing a wall of ferro-concrete, and erecting in it a three-lift holder equal in capacity to 280,000 cubic feet.

Apart from the necessity of increasing the storage capacity of the works, the single-lift holder had been constructed so that the pressure thrown was only 22-10ths. For several years the gasholder had been of almost no practical value, as the day pressure required to meet a largely increased demand for gas for engines and cookers is 30-10ths.

Incidental to the increased demand for gas during the daytime the following data may prove interesting. In 1892, when the last new holder was erected, the maximum daily output of gas was 220,000 cubic feet; the total storage available being 420,000 cubic feet. In 1912, the maximum daily output had risen to 640,000 cubic feet; the available storage being only 345,000 cubic feet. The real storage had been reduced owing, as already stated, to one of the holders giving insufficient pressure.

It has been freely argued that the storage accommodation should be provided sufficient for twenty-four hours' demand. The conditions, however, of gas supply have entirely altered, with the result that instead of a short-hour period of maximum demand, the use of gas for heating and power has brought about a large hour-to-hour requirement during the non-lighting period, and especially during the summer months. One may be permitted, therefore, to revise the old rule, and state that gas storage as a safe maximum should not exceed twenty-four hours' requirements at the time of greatest output; and that works having a storage capacity of (say) only 70 per cent. of the maximum twenty-four hours' demand is not justified in considering additional capital expenditure for a new holder, and especially so if the day demand has tended to equalize the requirements during lighting hours.

In regard to the day consumption of gas at Alloa, I find from the records that the amount of gas sent out in the day-time in 1892 was only 9½ per cent., and in 1912 53½ per cent.; while the annual output has increased from 45 to 150 millions. Having storage for only 345,000 cubic feet, and a maximum daily output of 640,000 cubic feet, this circumstance would have entailed considerable anxiety. This was undoubtedly the case at times when the manufacturing plant was not answering to the best efficiency; but on the whole the conditions of storage and supply referred to did not, in point of fact, in any way hamper the output or inconvenience the consumers.

I have dwelt somewhat on this phase of gas storage capacity, as I am conscious that there are many cases to be found of works with excess gasholder power and, needless to say, an inflated capital account. Safety in gas supply as regards ample storage (the need for which is sometimes only apparent and not real) can often prove expensive to a gas undertaking, in view of increased capital charges.

The old tank was brick built, having a puddle bottom. It was erected in the year 1862; and had proved water tight, and, generally speaking, was known to be in a satisfactory condition. The work of emptying the tank was completed in 25 hours; and for this purpose a Pulsometer centrifugal pump was used, direct coupled to a 6 H.P. electric motor, with 3-inch diameter suction and 3-inch diameter delivery pipes—the water being run direct to the River Forth (tidal) about 100 yards distant.

The dismantling of the old holder was then proceeded with. The crown sheets and framework were taken down, allowing the side sheeting to fall in—the latter being afterwards cut up and removed. The cross girders at the columns were taken adrift, and a chain was then fastened round the top of each column in turn and attached to a rope block. After the base-plate was broken from the foundation bolts, a strain on the block brought the cast-iron column to the ground. The material of the old holder was scrapped.

On examining the tank, it was found to be in splendid condition. As a precaution, however, it was decided to point the brickwork with cement; and after picking the joints, the walls were thoroughly washed with a pressure of water from a hose, preparatory to cementing, in order to clean out the joints.

The rest blocks had to be replaced by new ones, due to the difference in centres. They were made of cast iron and laid on a concrete foundation.

The required depth of the new tank being 20 ft. 9 in., it was necessary to raise the existing wall by 5 ft.; and consideration was given as to whether this should be brick built or ferro-concrete. It was ultimately decided to build a reinforced concrete circular wall to the required height. The reasons for adopting reinforced concrete instead of brick were as follows: (1) The relative lightness of the additional dead load superimposed on the old brick wall. 2. The superior water-tightness of reinforced concrete over brick—more especially in this case, where the superimposed wall is not backed by clay, but is entirely above ground. 3. The reliability of reinforced concrete against the bursting pressure of the contained water.

The inside diameter of the tank wall is 81 ft. 11 in.; and the thickness of the reinforced concrete circular wall is 8 inches.

Having stripped 15 inches off the coping of the old wall, a 4½-inch channel was cut out in the centre of the brickwork—thus forming a groove, and binding the old and new work together.

The standards of the gasholder are carried on ten reinforced concrete buttresses, equally spaced round the outer circumference of the tank; and the foundations of these buttresses were carried right down a considerable depth to a hard subsoil. In front of each buttress 4½ inches of the brick wall of the tank were cut out so as to tie the concrete to the old brickwork. In each buttress a vertical bar was placed at each corner, and kept in position by ⅜-inch diameter bars at 6-inch centres as shown in fig. 3 (p. 394). The buttresses were brought up to the ground level before cementing to the wall. After the concrete had set, the space left was filled in with puddle, which was well watered and rammed in.

At this point, the new 18-inch diameter inlet and outlet standpipes were also put in—allowing the ground to be cleared round about the top of the tank, and leaving more room to work at the wall. The old connections (12 inches in diameter) were cut off—care being taken to puddle and cement the open ends. To permit of the pipe being well under the level of the rest-blocks, it was necessary to excavate 6 feet below the bottom of the tank. The excavation having been completed, the concrete foundation for the drip-box was laid. A hole was cut through the wall to allow for the length of pipe; and a suitable concrete foundation was made inside the tank to receive the duck-foot bend. The drip-box, length of pipe, and duck-foot bend were then set in, connected together, and carefully tested. Concrete was packed round the drip-box and bend, until the top of the pipe was covered; the wall being rebuilt and puddled inside and out.

All this work had to be done expeditiously, owing to the great inflow of water; the water having to be kept down by a hand pump during operations.

The ground being cleared and levelled, the work of erecting the wall was started. The horizontal reinforcing bars of the reinforced concrete wall are carried into the buttresses; but the wall itself was sufficiently reinforced to resist the bursting pressure of the contained water without the aid of the buttresses. For this purpose, the main tensional reinforcement is carried horizontally, and the sectional area of the bars is reduced from the bottom upwards in proportion to the pressures. All horizontal bars were overlapped 4 feet, and thoroughly anchored in the concrete at their ends by means of right-angle bends; and vertical bars were also placed, staggered at back and front of the wall, to distribute the stresses—the two sets of bars forming a complete grillage of steel in the concrete (see fig. 2).

At the top of the reinforced concrete wall, a gangway or platform 1 ft. 8 in. in breadth was formed right round the tank, projecting in cantilever form from the wall 1 ft. 8 in. This was also constructed in reinforced concrete, 4 inches in thickness.

The holes for the bolts to fix the channel guides were built into the wall. The foundation bolts for the columns were set in position, and the buttress brought-up along with the circular wall. The horizontal bars in this case were tied into the wall, as shown in the illustrations. Each bay was treated in the same manner, until the whole work was completed.

The total weight of steel reinforcement used in the reinforcement of the wall, gangway, buttresses, and their foundations, was 6¾ tons. All steel used was ordinary commercial rounds, and was specified to be mild steel, having a tensile resistance of not less than 28 tons and not more than 32 tons per square inch of cross-sectional area, with an elongation of not less than 20 per cent. on a length of 8 inches.

The concrete used for the wall was made in the following proportions: Gravel, free from sand, and all to pass the ¾-inch ring, 27 cubic feet; sand, 13½ cubic feet; portland cement, 7½ cwt. This gave a particularly close-grained and dense concrete; and the concrete was also thoroughly consolidated when in position between the centring boards by means of vigorous ramming. No waterproofing compounds were used in the concrete, nor was any rendering of the wall after completion done. But after the removal of the boarding, the surfaces of the wall were brushed over with two separate coats of portland cement grout, thoroughly well rubbed in. The whole of the work was executed in a very tradesmanlike and satisfactory manner; and the reinforced concrete wall, since being brought into use, has been found water-tight. This portion of the work has proved eminently satisfactory in respect of efficiency and economy in capital cost.

The illustrations appearing on the next page show clearly the nature of the construction.

The 12-inch diameter bye-pass was formed in the event of any stoppage taking place, due to naphthalene in the inlet or outlet pipes. Experience had determined as to the necessity of the bye-pass arrangement, which is unusual, I admit. With the other

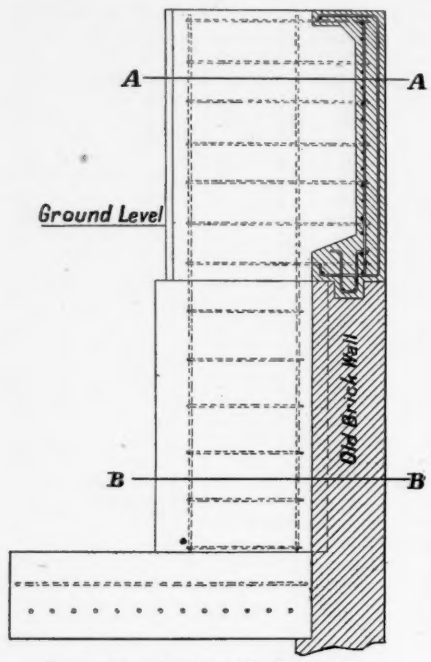


Fig. 1.—Cross Section of the Tank Wall.

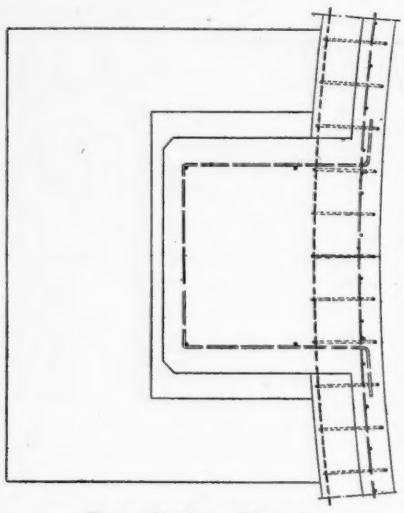


Fig. 2.—Section on Line A A.

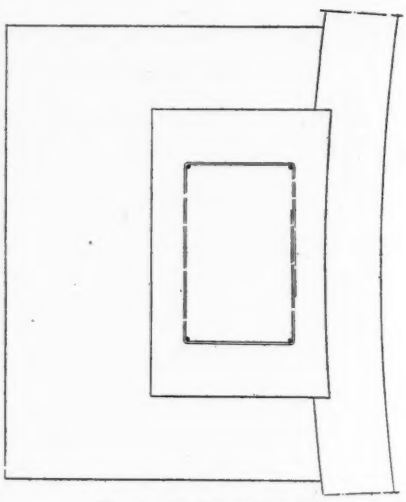


Fig. 3.—Section on Line B B.

large holder, on one occasion the inlet pipe became so seriously blocked with naphthalene as to require the fixing of two small bye-pass pipes to the outlet pipe, through which the gas being made was put into the holder until the block at the inlet proper had been removed.

The ferro-concrete wall when finished was left for a fortnight to ensure the cement being thoroughly set before the erection of the holder.

In erecting the holder the standards and cross girders were first placed in position—thus allowing the tank-guides to be set. The bottom curb of the inner lift to which the necessary guide rollers are attached, was laid on the rest-blocks; the vertical bars and crown framing then being erected.

Most of the side sheets were received riveted together for convenience at erection; the condition of the bottom of the tank being unsuitable to work on. The crown sheeting completed, the swan-neck brackets and handrail were fixed. Over the inlet and outlet stand-pipes, manholes were placed, also one in the side of each lift. The erection of the middle and outer lifts was carried out in a similar manner. The sheets and steelwork of the holder received a coat of linseed oil before delivery, and after erection a coat of Ferrodor paint (natural colour, dark steel grey), and a finishing coat of approved colour. The tank was filled with water from the town's supply, and the holder was thoroughly tested. Anti-freezing apparatus was fixed in each cup, and one on the lip of the tank, in the usual manner.

The gasholder, as erected, does not possess any special features. It is column guided; the question of a spiral-guided holder not being determined upon—having in view the structure of the tank wall being formed of old and new work.

DISCUSSION.

Mr. H. O'Connor (Edinburgh) said the subject dealt with by Mr. Mitchell was an exceedingly interesting one to him, because he had had experience of some of the earliest holders where a large amount of ironwork or steelwork was used in the construction of the tanks. He had also had experience recently in the designing of a tank of a small holder, and he had the idea of doing it with ferro-concrete. He had the figures of the cost of a tank of about 50 feet diameter and 20 feet deep. He estimated the cost of a steel bar tank at £448, and that of a tank of ferro-concrete at £441; and the actual cost with a concrete tank was £444. So that, as a matter of fact, the three different methods all came out within £7 of each other. His experience was that the actual cost of putting steel in a ferro-concrete tank amounted to about the same as steel for a tank solely of steel. In this case it was a very admirable arrangement to put ferro-concrete on the top of this old wall. But in ordinary cases he did not think it would be found of any great advantage.

Mr. Alex. Yuill (Dundee) congratulated the Junior Gas Association on having met in Dundee. They were all conscious of the benefits of their larger Association; and he thought it was a wise step on the part of the juniors to form themselves into an Association, because there were matters which could be brought before them and discussed which would not be suitable at the meetings of the senior body. In speaking of the Junior Association, he had a pleasurable feeling. He remembered the last meeting in Dundee, when they gathered in the Technical College. One of his assistants, Mr. Mitchell, then gave them a paper on the high-pressure system; and this had been followed that day by another paper by Mr. Mitchell's brother. Turning to the question of ferro-concrete holders, he said that personally he felt a delight in it. His earlier associations with Alloa made him thoroughly conversant with the problem. He was convinced that this was the only true solution of the case. The tank was so shallow that it was almost impossible to keep it from shaking in a gale of wind. He never had any confidence in it; and he was glad, for Mr. Napier's sake, that he had got rid of it. One of the golden rules used to be that the gasholder should have a capacity equal to 24 hours' consumption. This had been altered, because the day consumption had increased considerably, and in a great many cases what might be termed the maximum hourly consumption had not increased at anything like the same rate. Twenty years ago, it was quite the thing to find that in winter the make was about seven times as great as it was in summer. Now in some cases it was only double.

Utilization of Pitch.—The various kinds of pitch are found to be unsuitable for use on roads, as they readily become soft, and at low temperatures are brittle and fragile. Attempts have been made to improve them by the addition of various substances; but usually these fall to the bottom of the mass, so that the mixture obtained is not of uniform composition. A recent number of "Technique Moderne" contained a method of obtaining a homogeneous mixture; the following formula being given: 1000 parts of pitch are melted in a boiler, provided with agitators, at a temperature of 150° to 180° C. Then from 200 to 300 parts of sawdust are added, and from 400 to 500 parts of crushed chalk—all being mixed together in a uniform mass. Shavings or fibrous vegetable matter can be employed instead of sawdust, and marl, cinders, &c., in place of chalk. The viscous marl can be cast in a mould, or used immediately for road surfaces. Rolling is done either hot or cold. This composition is uniform, withstands the effects of heat and cold, does not shrink, and is found to be quite impermeable.

Doherty's Ammonia-Recovery Processes.—Three patents for processes dealing with the recovery of ammonia from gases have been taken out for the United States by Mr. H. L. Doherty, of New York, and the specifications have lately been published. According to abstracts in the "Journal of the Society of Chemical Industry," in one process the ammonia, carbon dioxide, and hydrogen sulphide are separated from the gas by absorption in a liquid, the gases are distilled off and mixed with sufficient oxygen to form sulphur dioxide, the mixture is passed over a catalytic material, and the ammonium salts in the resulting gas are recovered. According to another process, in order to convert the mixed ammonium sulphides and carbonates into more stable salts, they are heated so as to decompose them into ammonia and acid gases. The ammonia is separated, the acid gases are mixed with oxygen and then passed over a catalytic material, and the ammonia is mixed with the oxidized gases. The resulting gas is cooled, whereby a mixture of ammonium salts of sulphur-oxygen acids is obtained. By the third process, the ammonia, carbon dioxide, and hydrogen sulphide are separated from the gas, and the ammonia is separated from the acid gases, which are mixed with sufficient air or oxygen to form water and free sulphur; this reaction being brought about by means of a catalytic material. The free sulphur is separated from the resulting gas, and the gas is mixed with ammonia at a temperature below that at which the sesquicarbonate dissociates, whereby a hydrated carbonated ammonium salt is recovered.

SCOTTISH JUNIOR GAS ASSOCIATION.

WESTERN DISTRICT.

A Meeting of the Western District Division of the Scottish Junior Gas Association was held in the Royal Technical College, Glasgow, last Saturday—the PRESIDENT (Mr. F. L. MacLaren, of Dumbarton) in the chair.

Mr. T. CARMICHAEL (Dawsholm) read the following paper:

GAS FOR HEAT, POWER, AND LIGHT.

Remarkable strides have been made, and are being made almost daily, in improvements to cheapen the cost of the production of illuminating gas; and new methods of manufacture have been evolved to satisfy the quality now demanded of town's gas. Starting with the retort-house, there have been important departures from the original arrangements. It is unnecessary for me to occupy your time in enumerating all the different systems of carbonization of coal; but, in view of the opportunity which will be afforded to the members this day fortnight of inspecting the vertical retorts at the Dawsholm Gas-Works, and the fact that vertical retorts are conspicuous among the improvements in gas manufacture during the past few years, I shall endeavour very shortly to describe this system.

Verticals are, perhaps, the most rational form of retort, and they are certainly the oldest; but until recent years their use has been beset with difficulties, owing to the hanging-up of the charge, and the want of satisfactory charging and discharging apparatus. These difficulties have now been overcome, and many engineers have been considering the adoption of verticals. The vertical retorts may be divided into three distinct types—intermittent, continuous, and intermittent-continuous. They have many advantages in common, and all of them have improved and cheapened the methods of manufacture, and so helped to bring about the more universal use of gas in our towns, not only as an illuminant, but also as a source of heat and of motive power. Intermittent retorts are exemplified by the Dessau system, and are generally used on the Continent; the continuous system, by the Glover-West and Woodall-Duckham settings.

Glasgow Verticals.*

The Glasgow verticals are the invention of Mr. Alex. Wilson, M.Inst.C.E., and are on the intermittent-continuous principle—intermittent because drawing and charging are performed at definite intervals of from three to four hours, and continuous because only a portion of the charge is drawn, never reducing the contents of the retorts by more than a third. Six benches of this system have been installed at the Dawsholm Gas-Works, each bench containing four settings of six retorts—making a total of 144 retorts in the complete installation. The retorts are brick built, 23 feet long, and are oblong in section, tapering from 40 in. by 10 in. at the top to 48 in. by 18 in. about half-way down. The bottom portion is parallel. The number of retorts per setting is adjusted to suit the particular works; and at Dawsholm they are grouped in settings of six retorts, and each setting is provided with its own producer and regenerators for heating the secondary air. The producer is on the floor-level, and is of the ordinary horizontal internal type, but much larger, and is extended to the top of the bench, so as to contain the day's supply of coke.

The ovens and retorts are supported on columns and steel joists, and are sufficiently high above the ground to permit of a bogie being run in below the coke-chambers, to allow the charge to be drawn. The whole structure is bound together by vertical buckstays and horizontal binders. The coal hoppers, which contain 48 hours' supply of coal, are supported by columns from the top of the buckstays. They are filled by elevators and conveyors in duplicate sets, so arranged that either side can supply the whole installation. The coal, after being discharged from railway waggons by hydraulic tippers into a large hopper, is allowed to run on to a small regulating conveyor, which can be worked at a speed varying from between 20 and 90 feet per minute, and is passed over a screen to allow the small coal to fall to the bottom of the elevator; the larger coal passing through the coal-breaker, whence it is lifted by the elevators and conveyors and deposited in the coal-hoppers above the benches. The elevators are of the inclined, enclosed bucket type; and the conveyors are of the roller push-plate type, and are capable of dealing with about 40 tons of coal per hour. There are two gas-engines of about 35-H.P. for driving the elevators and conveyors; and all shafting is run in ball-bearings, fitted with dust-proof plummer-blocks.

The coke-chambers are extended down below the steel joists a distance of 6 feet, and are constructed of cast iron. They are gradually contracted in section, until they terminate in an aperture about 20 inches square, and are enclosed by a cast-iron movable bucket containing water. These buckets, or cradles, are opened and closed for the drop of the charge by small hydraulic rams. On the top, the retorts terminate in cast-iron mouthpieces, to which are connected the coal-charging valves and outlet-pipes—in other words, what are commonly known as ascension-pipes. The coal-hopper is connected to these valves by means of telescopic shoots.

* The author directed attention to the illustrations of these settings that accompanied Mr. Wilson's Presidential Address to the Institution of Gas Engineers, at the Glasgow meeting, 1911. See "JOURNAL," Vol. CXIV., pp. 732-3.

Gas from the producer is led to the top of the setting, where it meets the hot secondary air necessary for its complete combustion, and is burned between and around the retorts. The products of combustion are then led from the ovens to the waste-gas flues, which are adjacent to the secondary-air flues; and the waste gas assists by its sensible heat to warm the newly-admitted air, which enters at the bottom of the regenerators, and passes upwards to join the producer gas at the combustion chamber at the top of the setting. The producer furnaces are fed once every 24 hours; and half of the fire is cleaned every 24 hours, or the whole furnace once in 48 hours. Ample provision is made for inspection of all flues and regenerators, and also for the taking of temperature, and of samples of waste gases for analysis.

To discharge a retort, the coke-bogie is run under the bucket containing the water-seal, which is then pushed back by the turning on of the high-pressure water to the cylinder. The coke falls through the opening until it fills the measure or bogie, and is discharged in a cool state, and therefore does not require quenching. The bucket is then drawn back, and cuts through the column of coke resting on the measure, and closes the retort; and the water-seal is refilled. Drawing the coke causes the charge to drop, and leaves a vacant space at the top of the retort, which is then filled by gravity with coal from the opened coal-valve, which is afterwards closed. The new charge is deposited in the hottest portion of the retort, and remains there at rest for a period of four hours, until the next draw takes place.

The gas passes through each retort from the outlet in the cast-iron mouthpiece into the ascension-pipe, through the dip-pipe, into the hydraulic main, which is provided with tar and liquor weir-valves, set to give a very light liquor seal, and thence to the foul main. A retort-house governor is provided at the end of the foul main, in order to keep the retorts at a level-gauge, or under slight pressure at top and bottom.

As you will have noticed from the description of their working, these vertical retorts have taken advantage of the cheapest force in Nature—namely, gravitation. The elevators and gas-engines are in duplicate, and there is a complete absence of machinery about the retorts (only a small hydraulic cylinder being required to open the door when discharging). There is practically no risk of serious breakdown or stoppage in the manufacture of gas.

The coal gas, after its proper production by the method just described, or by any of those mentioned at the beginning, is subject to ordinary purification, where it is the aim of the manufacturer to remove or eliminate to the greatest possible extent all the impurities which not only are not required for illuminating purposes, but which prove fatal to good results being obtained.

The Gas Supply of To-Day.

The gas as now supplied is of an entirely different quality from that which was supplied some years ago. Before the advent of incandescent lighting, flame luminosity was of the first importance, and the illuminating power was the test of the value of gas; 16 candles being the average in England, while Scotland had a much higher standard of 20 candles and over. However, in Germany, where incandescent lighting is very general, and has almost entirely ousted flat flames, the usual gas is of 12 to 14 candles, but of a fairly high calorific value—namely, 500 B.Th.U. A gas like this is known as a low-grade gas; and the trend of affairs is to supply such a gas with the guarantee of a calorific instead of an illuminating value.

It is well known that the gas made 25 years ago was sold almost entirely for illuminating purposes, and consumed in flat-flame and other luminous burners. To-day, these luminous burners have been superseded by upright and inverted incandescent burners; and reliable authorities tell us that, instead of 5 per cent. of all gas manufactured being used for incandescent lighting and heat and power, from 80 to 85 per cent. is employed for these combined purposes, and not more than 15 per cent. for lighting by the old flat-flame luminous burners. So the problem to-day is to supply the greatest number of heat units at the lowest possible cost, in such a form as is most suitable for the requirements of consumers—*i.e.*, for giving favourable results with incandescent mantles for lighting, while economical for use for cookers, gas-fires, and gas-engines.

LIGHT.

After dealing briefly with the subject of luminous and non-luminous flames, the author remarked that the supply of artificial light was at one time a monopoly in the hands of the gas companies, and because of this a certain amount of independence was shown; and consequently little was done to push the sale of gas, or to encourage the consumers in the use of it. This state of affairs is now past, and all progessive undertakings are pushing for business like other commercial firms.

As regards incandescent burners, there has been a lot done of late years in the direction of remedying the imperfections of the earlier forms; and they are now made to ensure perfect combustion, so as to prevent the waste of light-giving power—thus getting rid of the charge of gas blackening ceilings and of evil-smelling gas Incandescent fittings can be bought at a very low price; and as mantles are very durable, the cost of upkeep is negligible. By the perfection of incandescent burners, gas has greatly developed for illumination, and is without doubt the most economical method of lighting for all purposes. The following extract from Mr. Wilson's Presidential Address to the Institution of Gas Engineers

in 1911 will show the great economies that have been effected to the consumers through the use of these burners.

From the examination of a large number of cases, it appears that, compared with flat-flame lighting, the adoption of ordinary incandescent burners by householders and shopkeepers reduces the quantity of gas consumed for lighting purposes by from 20 to 50 per cent.; while in the case of a considerable number of large consumers, who have installed high-pressure systems of lighting in their works and yards, the saving of gas runs sometimes to as high as 70 per cent.

I think sometimes that not enough is made of the cheapness of incandescent gaslight with modern burners. Few customers nowadays, through the extension of the application of gas for cooking, heating, ironing, and hot-water service, really know how little gas they are actually using for lighting. I heard of a case some time ago where a householder had installed the electric light while gas was retained for cooking and heating. At the end of the quarter, an account for something like £3 came in for electric light, while the gas bill was reduced by only 17s. 6d.—showing that the greater portion of his gas is now used for cooking and heating.

Relative Costs.

A comparison of the relative cost and efficiency of gas and electric light will show whether there is any present fear of gas being superseded. The efficiency of incandescent burners has increased with the improvements in the burners; many manufacturers claiming that they have attained comfortably 30-candle power on the low-pressure system, while with the use of higher pressures this figure has been raised to between 60 and 70 candle power per cubic foot.

With gas at (say) Glasgow price for lighting—1s. 11d.—and an efficiency of (say) 22 candles per cubic foot, we find that one 64-candle power inverted burner will consume 3 cubic feet of gas per hour, and for 1000 burning hours will consume 3000 cubic feet of gas, costing 5s. 9d.

Two 32-candle power metallic filament lamps, with an efficiency of 1 watt per candle power (in practice, nearer 1·25), will consume in 1000 hours $64 \times 1000 = 64{,}000$ watts, or 64 B.T.U., which, at 3d. per unit, equals a cost of 16s. This means a saving in favour of gas of £1 0s. 6d. a year for each burner used, assuming the number of lighting hours to be 2000 per annum. This is based on a light-for-light comparison, and is the only true method of judging the relative costs. Maintenance of the two systems is very often neglected, but should always be taken into consideration when making comparative costs; and the difference in this maintenance charge in favour of incandescent gas light is generally taken at the difference in price of a good metallic filament lamp and two good gas mantles. The price of a good metallic filament lamp is 3s., while mantles are only 6d. each.

Incandescent lighting has also another beneficial advantage over our rival, of assisting in the natural ventilation of a room. There are designs in abundance of efficient ventilating gas-lights; and many of our large buildings have taken advantage of this ventilating property of gaslight in assisting in the natural ventilation and rendering the atmosphere of these places healthy and agreeable.

Fire Risks.

Regarding the fire risks of the two illuminants, attempts are sometimes made by the advocates of electricity to emphasize the danger in the use of coal gas. With gas, its smell warns the consumer of danger when there is an escape; but with electricity, one does not know when or where there may be trouble. Electricity is therefore not safer than gas, as will be observed from the number of disastrous fires attributed to electricity during the past few years. Though electric light is certainly convenient, this advantage is fast disappearing, with the introduction of the pneumatic gas-switch, spark ignition, and other distant-lighting devices. Yet other points in favour of our illuminant ought also to be urged strongly—such as brilliancy, purity, and economy.

Gas for Heating.

Heating by gas has come to be regarded with increasing favour. The use of the gas-fire is rapidly extending, and this important part of the work involves first the study of the different methods of transmission of heat. These are conduction, convection, and radiation; and the last two are the ones which concern us most. In the earlier days, gas-fires were made to heat by convection; but to-day the ideal fire is designed to give the highest possible percentage of its heat by radiation. With the old fires, the method of procedure seemed to be to make an artistic looking article, irrespective of heating value or efficiency. A burner was simply put in, with an aperture for the air supply, and the fuel was thrown into the fire in any position. But the modern fire contains a burner with gas and air adjusters, Venturi tube, adequate flue, efficient canopy, copper reflector, small fire-bars, and carefully shaped fuel, so that the flame will pass up the centre and be allowed to burn itself out. After these considerations, the makers then study how best to make the fire look artistic.

The use of gas for cooking, and many other household purposes, is still growing. Gas undertakings find that the day consumption is now approaching that of night; and this more even working is bound in time to cheapen the cost of gaseous fuel. At no distant date gas should be equal in cost for continuous burning to the present wasteful system of consuming coal in an ordinary grate.

The commercial uses of gas for heating are almost unlimited in cases where the following advantages are important: (1) Constant supply ready at a moment's notice. (2) Can be applied economically to very small heating appliances. (3) Clean, and no solid waste products. (4) Can be put anywhere. (5) Points of application of heat can be easily varied. (6) High temperatures can be easily attained and maintained. (7) Variations of temperature easily secured. Great possibilities lie before the use of high-pressure gas for heating; and most important developments have been made in several places. It admits of higher temperatures than are possible with low-pressure gas. Compression has no effect in the total quantity of heat from gas; for the heat is the same, no matter what the conditions of burning are, so long as combustion is complete. Compression, however, concentrates the flame, increasing its temperature, and producing greater thermal efficiency. Burners, &c., are constructed for a pressure of 54 inches of water; and the use of gas for these purposes enables half the ordinary consumption to be saved.

Electricity for heating is absolutely out of the running, as the following figures show that about six times the quantity of heat can be bought for a penny with gas as with electricity. Gas at 2s. per 1000 cubic feet of 550 B.Th.U.; electricity at 1d. per unit. Gas equals 22,550 B.Th.U.; electricity, 3500 B.Th.U.

The Question of Power.

To the two methods already mentioned of burning coal gas, we can add still another, for power purposes. In the supply of power, coal gas has always taken a prominent part; and the demand for gas should still further increase with the adoption of the modern gas-engine and with the reduction in the price of gas for power purposes. Where coal gas for power purposes is reasonably cheap, gas as a prime mover is very good, on account of the following advantages: (1) The small space necessary. (2) Ease of starting. (3) Certainty of supply. (4) Little attention required when running. (5) Small initial cost compared with suction gas. (6) Less wear and tear. The chief competitors for power at present are steam, electricity, and suction gas. On comparing with steam-engines, the results are greatly in favour of gas; but above 10 or 15 H.P., we have to reckon with suction-gas plants, which produce power gas at a very low cost. It is now generally recognized that a combination of engine and producer plant affords a most economical and fairly reliable means of deriving cheap power. In working these plants, a little extra attention is required (as compared with town gas engines) in charging the generator every two hours with fuel. The other disadvantages are: (1) Higher initial cost. (2) Extra cost in repairs. (3) Uncertainty of starting. (4) Extra cost of attention. Where the price of gas exceeds 2s., the disadvantages of extra items for repairs and attention are soon more than repaid by the installing of suction-gas plants when engines are over 10 or 15 H.P.; and the difficulty of uncertain starting is sometimes got over by connecting-up to the town gas mains for emergency.

Comparing the running costs of these two systems, we see that coal gas for power purposes at 1s. 6d. per 1000 cubic feet is cheaper than suction gas with anthracite at 25s. per ton.

Suction Gas.—Allowing an efficiency of 1·2 lbs. of fuel per B.H.P. per hour, a 20 H.P. engine will use $1{\cdot}2 \times 20 = 24$ lbs. of fuel per hour. With anthracite at 25s. per ton, this will cost 3·21d. per hour; and extra items of labour, &c. (say) 0·2d. per B.H.P. per hour = 4d.—making, therefore, a total running cost of 7·21d. per hour.

Coal Gas.—Useful horse power for 16 cubic feet per hour; and with gas at 1s. 6d. per 1000 cubic feet, a 20 H.P. engine will cost 5·76d. per hour. Some gas-engines have also been replaced by electric motors, which, though costing a little more, are often, it is said, put in for convenience where intermittent use only is required. Up to 4 or 6 H.P., and used for only a few hours per day, the modern quick-running gas-engine is as convenient as the electric motor, is not dearer in first cost, and is much cheaper in cost of running. Electric people are making headway here; and we should put forth every effort to retain present customers, and also to induce others to adopt gas for this purpose.

Electric Motor.—To give a useful horse power, it requires 746 watts per hour; and if the price per unit be ¾d., 20 H.P. will cost about 11¼d. per hour (allowing full efficiency).

It is obvious, from these remarks and comparisons of costs, that gas for light, heat, and power is still making progress; and so long as the price is kept down to about 2s., we need not fear the opposition of any competitor.

DISCUSSION.

Mr. David Fulton (Helensburgh) said he wished to be the first to thank Mr. Carmichael for his paper. He had given them many interesting facts and figures, bound to be of service to them all. His description of the Glasgow vertical retorts was very interesting; but there was an absence of any working results. Knowing that Mr. Carmichael had been in charge of these retorts for several months, they hoped that at some future date he would give them the benefit of his experience, and tell them what the retorts could do. He (Mr. Fulton) thought that maintenance should be free. Some even said that free mantles should be supplied; but he hardly went so far as this. With the traders, the best burner was the one which gave the largest profit; and they allowed the artistic ideas of the consumer too much free play. Hand-painted globes might be artistic, but were useless as light diffusers. He said fight the traders. He thought Mr. Carmichael

had dismissed too lightly the competition of electricity in the region of power. It seemed to him that every one of the advantages held by town gas over suction gas, with the exception of cost, was held by electricity over town gas.

Mr. LITTLEJOHN (Glasgow) did not agree with Mr. Carmichael in his assertion that the lower illuminating power of the flat-flame burner was due to the higher pressure at which the gas was emitted. He also held it was a mistaken idea that radiated heat did not influence the temperature of the medium. Though electricity was six times as dear as gas for heating, when they came to power the state of affairs gave food for reflection. Why was it that their gas was only half the price of electricity when they came to use it for power purposes, though it had six times the heating value?

Mr. WHITELAW (Glasgow) said that Mr. Carmichael, in his paper, stood on safe ground. The maintenance of electric light was very much higher than that of gas. The longer the lamps were in use, the greater became the demand for current. Instead of taking the guaranteed quantity of current, they took 50 per cent. more. Regarding the question of free maintenance, it was not only a case of renewing mantles; in many cases the burners were at fault. An expert staff would be absolutely essential. When people went in for electric light, the question of cost did not come into account at all; but if a manufacturer was going to light up his factory, he considered what was going to be the cheapest, and selected gas. He fully supported Mr. Carmichael in his ideas on radiated heat.

Mr. J. WILSON (Falkirk) held that if they supplied gas of 14-candle power and kept it at this, their gas was good. If they started giving out 18-candle gas one day and 16-candle the next, then the gas was bad. Gas at 14 candles, and kept constant, was good. One of the main factors was to keep the gas at a uniform quality; and if they did this, they got rid of the many complaints of bad gas. As for free maintenance, it was bound to come. About 90 per cent. of the complaints were due to bad fittings. The consumer should, of course, pay for such renewals as were necessary. In the competition with electricity, they need have no fear if they could keep the price of gas down to 1s. 6d. per 1000 cubic feet.

Mr. J. FRAZER (Provan) claimed the credit of having brought up the subject of free maintenance. He said the great thing necessary for the realization of the idea was to have all the burners standardized.

Mr. J. BELL (Kirkintilloch) thought they did not need to go so far as had been suggested in the direction of free maintenance. He found that people were very receptive in understanding how the incandescent burner ought to be cleaned and regulated. His policy was to instruct his men, when they were out in the district, to convey the necessary information to the consumer, who adopted it in a very intelligent way. He thought free maintenance would throw a burden, and a very unnecessary one, on the cost of gas. With regard to power, he held that they were "up against" the suction producer, and were beaten hollow. He would give a practical instance of this. In his district, where they supplied gas at 2s., one firm had installed a 29-H.P. engine with suction producer plant; and the result was that it provided the instance of suction-gas plant running for 3d. per brake-horse-power-hour. He did not think they ought to be misled with theoretical statements. He was misled, and found it out to his cost. The only way to prosper in the competition was to make their gas still cheaper. The companies and local authorities should allow a sliding-scale for power, so that the big consumer would get the cheapest rate. They were all watching for results with regard to vertical retorts; and it was only a matter of time when they would have all carbonization performed in these retorts.

Mr. WALTER GRAFTON (Glasgow) said Mr. Carmichael had dealt with gas for light, heat, and power; but he regretted that he did not go into the subject of the composition of the gas, and give figures to show the relative efficiencies of the various constituents. They wanted the gas to contain constituents which required large volumes of air to properly consume; and Mr. Carmichael might have said something as to whether, with the vertical retorts, such a gas as was needed was obtained.

The PRESIDENT, in closing the discussion, said he fully endorsed Mr. Whitelaw's remarks that heating by radiation did not raise the temperature of the atmosphere. The strong point about gas was that, as a method of heating, it could not be ousted by any other medium. This was the great outlet for the gas industry. The field for heating was becoming wider and wider every day. The electric motor was greatly superior to the gas-engine for high-speed work; and gas-engine makers should try to manufacture an economical engine working at a higher speed.

Mr. CARMICHAEL, in reply, said the blackening of ceilings was not due to dirty gas or imperfect combustion. He accepted Mr. Bell's figures regarding suction gas. On the subject of electric motors, he instanced a case of a millowner who, to secure individual driving and so save the cost of upkeep of shafting necessary with a gas-engine, installed electric motors. Previously his bill for power amounted to £500; and the electricity people stated that with electricity this amount would not be increased. Certainly, the first quarter's account was at the rate of £500 per annum; but the bill had steadily increased, until it was now at the rate of £640 a year. This was what the electricity people did to secure business.

On the motion of the SECRETARY, a hearty vote of thanks was accorded to Mr. Carmichael.

EVERY-DAY EXPERIENCES IN GAS DISTRIBUTION.

By JOHN FERGUSON, of Forfar.

[A Paper read before the Scottish Junior Gas Association (Eastern District) Feb. 8.]

The following paper is intended to bring to the notice of the members some of the experiences that daily come under the eye of any who may be in charge of the outside departments of the various gas undertakings represented.

We should always treat complaints as being genuine, and first of all convince ourselves that the consumer has a grievance, and then make every endeavour to find out whether the complaint originates at the gas-works or at his end of the supply. We thus create right off a good relationship between supplier and consumer. There should never be the slightest hesitation in cleaning burners or gas appliances, and in explaining the best and most economical ways in which the gas may be utilized. The first essential to a good supply is good pressure. Nowadays it is advisable that the day and night pressure—except, perhaps, that between midnight and 5 p.m.—should not show a large difference, on account of the need for correct regulation of all bunsen jets, which, of course, mean all lighting burners, cooking appliances, and fires.

The pressure obtainable at the gas-works is limited to that which an inner lift of a gasholder will throw; and it cannot be exceeded unless other means are taken of raising the pressure. These means are not general in small gas-works; and most places must be satisfied with a pressure at the governor outlet of from 35-10ths to 40-10ths water-gauge. The next essential is that this pressure should not fall below 20-10ths at any part of the area of supply at the inlet of the consumer's meter. The meter itself should be of such a size as will not be overdriven, and thus cause further loss of pressure. Then, finally, the consumers' pipes should be adequate, so that the putting on of extra lights does not effect those already in use. These ideal conditions are seldom met with in practice; and here is where the difficulties of good service begin.

When one goes to inquire into the nature of a complaint, the pressure-gauge will show what available supply there is, and the drop in pressure be noted as each appliance is turned on. A pin-hole may be made in the lead or composition piping at the meter-inlet; and a hard piece of rubber tubing pressed against this will hold quite tight for the purpose of the test. If the drop in pressure at this point is not excessive, we may infer that at least the service is all right. The same procedure at the outlet of the meter will tell us to what extent the supply is being affected by the pressure taken up in working this; and we are then in a position to say whether it is the service, the meter, or the house supply pipes that are at fault. In the smaller class of house, this method is not necessary to the same extent, as the case is simpler. One can form an opinion very much more quickly; but even here the pressure-gauge is of the utmost service, and should not be done without.

One ought to set out to a job with the determination that every complaint can be remedied; and generally matters will turn out to the advantage of the gas supplier, in the shape of an increased and better supply of light to the consumer. Rusty services and badly-made joints are often a source of deficient supply. The service-pump is a ready means of clearing choked services; but in many cases it is necessary to renew these. When this opportunity presents itself, nothing less than ¾-inch piping should be put in. In Forfar, we have comparatively large trunk mains, on account of their being laid to supply the different factories, which some fifteen years ago were our largest consumers, but which now, with one exception, generate their own electric current. These mains are fairly well distributed throughout the town; and this makes matters easier, so far as the centre of the district is concerned. But there are two outlying places where the mains are deficient, and will require renewing. Charts taken at different points on the main during the month of August are available for inspection; and it may be as well to detail the drop that takes place along the route.

First District.

	Minimum Pressure. Tenths.
1st point, situated 1400 yards from the works	18
2nd " " 1600 " " "	17
3rd " " 1900 " " "	15
4th " " 2000 " " "	12

Second District.

	Minimum Pressure. Tenths.
1st point, situated 1100 yards from the works	23
2nd " " 1300 " " "	22
3rd " " 1500 " " "	21
4th " " 1900 " " "	20
5th " " 2400 " " "	17

One of the outlying districts is a residential one, containing some large consumers; and it is evident that something will require to be done during the coming summer so as to raise the pressure above 20-10ths at the main. As a rule, consumers are willing to pay for increased light; but one occasionally comes across an individual with a poor supply, which has been improved 50 per cent., and who wonders at the increased size of the next

gas bill. This sort of complaint must always be treated with every consideration. It is no answer to tell a consumer that he has used the gas, and must pay for it. The meter should be re-inspected, the pipes tested (and the meter also, if need be), and all heating and lighting appliances examined; and if the consumer is not then satisfied, he will have cause for forming the opinion that his complaint has been dealt with in a spirit of fairness.

On fixing several gas-fires in Forfar, we had one or two complaints of immoderate increases in the gas accounts; but after analyzing the accounts, and showing the consumers the cost per day or hour, we generally managed to send them away satisfied. By pushing the use of cookers, hotplates, fires, and all appliances for heating, our maximum daily output has increased from 206,700 cubic feet in 1910-11 to 237,600 cubic feet in 1912-13—an increase in three years of 15 per cent.—while our minimum daily consumption has increased from 91,200 cubic feet in 1910-11 to 112,700 cubic feet in 1912-13—an increase of 23·57 per cent.

	Cookers, Hotplates, &c.	Fires.
In the year 1910-11 we fixed . . .	187 ..	37
,, ,, 1911-12	345 ..	122
,, ,, 1912-13 (to Jan. 15). . .	123 ..	100
Total. . .	655 ..	259

Prior to the opening of a show-room, we found the distribution of art-blotters (on which were lithographic prints of some of the best paintings of our most eminent artists, and alongside these advertising matter dealing with the many uses of gas) a most useful means of advertisement. They were sent out each month with fresh matter, and resulted in many inquiries being made at the gas-works concerning all sorts of appliances. The blotter being a handy and much-used article, in itself ensured our advertisement telling its story often throughout a month.

In September of last year, a show-room was opened, as it was found that there was a steady demand for apparatus of all sorts. This is situated in the centre of the town, where we have displayed all the latest in heating and lighting appliances. In the window is fixed a demonstration meter, showing the consumption and the lighting effects of a flat-flame and incandescent burner switched on and off alternately; a meter demonstrating the lighting effect of a bad burner and the improvement secured by an economizer being automatically placed on this burner by a lever connected to the main spindle of the meter. There is also a fan kept working, in order to advertise its usefulness in preventing any sweating of the window-panes. The interior is lighted by two 300-candle power lamps; and there is shown a good selection of the various makes of side brackets and pendants fitted with the "Telephos," "Switch-on," or "Pneumatic Push" arrangement, so as to demonstrate the adaptability of gas as a lighting agent. The outside is lighted by means of two three-light lamps placed well up above the sign, so that the pavement in front of the shop is lighted as well as the window itself, which has the assistance of two pendants inside. We have been the means of increasing the number of outside advertising lamps since demonstrating the attractiveness of these; but I should like to state that, in my opinion, in some cases too much light is thrown into the window by means of concave reflectors, instead of having a bright illuminated frontage, which is always a good drawing source. These lamps are better lit by means of a separate bye-pass arrangement, worked from a stopcock inside the shop—thus obviating the use of a stick and stopcock outside.

Distribution of literature and pamphlets on "How to Handle the Incandescent Burner" and a card "How to Read the Meter" is, we think, a step that is likely to result in an added consumption of gas and a better understanding between the consumers and ourselves. The gas-fires are sold to the public and fixed free, the work being undertaken by local plumbers, and each job inspected by us after the fire has been fixed and is working. Cookers are let out on simple hire, and fixed free. The trade is supplied with all gas-fittings, burners, mantles, &c., at prices that enable them to make a legitimate profit on the sale to the consumer. This business is one which was, until the opening of the show-room, entirely in the hands of the local plumbers; and the arrangement is not being departed from now. We hope in time to be able to give the consumers only the best lighting appliances obtainable, as we have always so far striven to do in the matter of heating.

Though nothing has been attempted in the way of high-pressure lighting direct from the works, it may be interesting to state that in September, 1911, a high-pressure system of gas lighting was introduced into the factory of one of our largest consumers, who did not during the first craze for electric light depart from gas, and who is to-day reaping a decided advantage. Some 500 flat-flame burners, which, in practical working, could not claim an illuminating power of more than 16 candles each, have been replaced by 273 60-candle power incandescent burners; and the consumption of gas over one year has been reduced from 527,600 cubic feet to 270,900 cubic feet—a decrease of 51·34 per cent., with an increase in lighting efficiency of more than double.

Summarizing, in closing, the points touched upon, I should like to emphasize the following:—

1.—Good supply means a pressure at the consumers' meters of 20-10ths during maximum output.

2.—Meters should be always too big, rather than too small.

3.—Every endeavour should be used to get proprietors to consider the existing arrangements of the piping of houses which are inadequate.

4.—Complaints of bad lighting service are best investigated during lighting hours.

5.—The gas undertakings who are responsible for the supply of gas ought, as far as possible, to endeavour to help the consumer in the choice of apparatus with which to get the best results in both lighting and heating.

In the author's absence, the discussion on the paper was held over until the next meeting.

CALCULATING HEAT IN GAS VAPOURS.

Some months ago, an inquiry was sent to the American "Gas Institute News" for a method of calculating the total heat in a saturated gas vapour at any temperature; and the following answer by Mr. Herbert Sherwood, of the Westchester Lighting Company, Mount Vernon, New York, is contained in the current issue of the periodical named.

It is presumed that the information desired concerns those vapours which usually saturate industrial gases, such as coal gas, carburetted water gas, &c. Furthermore, the term "vapour" is taken to mean the gaseous state of each of those constituents of industrial gases which may also appear in the liquid form under the usual standard conditions of 60° Fahr. and a barometric pressure of 30 inches of mercury.

In measuring the total heat of a vapour saturating a gas, a temperature of 0° C., or 32° Fahr., is usually chosen as a starting-point, though any other convenient temperature may be selected. Whatever may be the temperature chosen, the following general formula may be used to calculate the total heat in a vapour saturating a gas:

$$H = S\,(T' - T) + L + C\,(T_0 - T)$$

Where

- H = total heat in B.Th.U. per pound of vapour above T degrees Fahr.
- S = mean specific heat of liquid form between the temperatures T' and T.
- T' = temperature in Fahrenheit degrees at which the liquid is considered to evaporate.
- T = temperature in Fahrenheit degrees above which the total heat (H) is to be calculated.
- L = latent heat of evaporation of 1 lb. of liquid at the temperature T'.
- C = mean specific heat of saturated vapour at either constant pressure or constant volume between the temperatures T_0 and T'.
- T_0 = temperature in Fahrenheit degrees below which the total heat (H) is to be calculated.

It should be noted that the latent heat of evaporation of different liquids is not constant, but varies somewhat with temperature. Thus 1 lb. of water evaporated from and at 60° Fahr. into vapour requires, according to Regnault, about 1072 B.Th.U.; while the evaporation from and at 212° Fahr. demands only about 966 B.Th.U.

When the rate of change of the latent heat of evaporation of a liquid is known over the temperature range considered, it is customary to use a value for C which is the specific heat of the liquid and its saturated vapour combined. Thus it requires 1 B.Th.U. to raise 1 lb. of water 1° Fahr.; and to evaporate it at 1° Fahr. above the original temperature it requires about 0·695 B.Th.U. less than at the original temperature. Hence 1 − 0·695 (0·305) B.Th.U. is required; and the value 0·305 may therefore be used as the specific heat in the equation. For strict accuracy, it should be noted that the specific heat of a vapour varies with the temperature range; being usually greater with increase.

The latent heats of evaporation of different liquids at various temperatures, with the possible exception of water, are rarely tabulated at temperatures other than 0° C., or 32° Fahr., and at the boiling-point under atmospheric pressure of each liquid. Therefore, it is customary to choose 32° Fahr. as a starting-point above which to calculate the total heat, and also as the temperature at which the liquid is evaporated. This is equivalent to making $T' = T = 32°$ Fahr., which simplifies the formula as follows:

$$H = L + C\,(T_0 - 32)$$

At the best, the calculation is usually only approximately accurate, as, with the possible exception of water, there are not sufficient reliable data concerning the various latent heats of evaporation and the specific heats over various temperature ranges of constituents found as vapours in industrial gases. However, by simplifying the formula, somewhat fairly accurate results may be obtained.

The latent heats of evaporation in B.Th.U. per pound of some liquids found as vapours in industrial gases are as follows:

	At 32° Fahr.	At 212° Fahr.	At 175° Fahr.
Water (H_2O) . . .	1091·7 ..	966·6 ..	—
Benzene (C_6H_6) . .	196·2 ..	— ..	167·2

The total heat per pound of water vapour saturating a gas at 100° Fahr. and constant atmospheric pressure would be—

$$H = L + C\,(T_0 - 32)$$
$$= 1091{\cdot}7 + 0{\cdot}305\,(100 - 32)$$
$$= 1112{\cdot}4 \text{ B.Th.U.}$$

AMERICAN INVESTIGATION ON CALORIMETRY.

Report of the Committee of the American Gas Institute.

It was mentioned, in the course of the general notice of the proceedings at the seventh annual meeting of the American Gas Institute which appeared in the "JOURNAL" for the 5th of November last, that Mr. J. B. Klumpp, the Chairman of the Committee on Calorimetry, presented a report embodying the results of their labours, which had extended over two years, and, in connection with previous work, had necessitated about two thousand tests. As the Committee had accomplished the work for which they were appointed, and the testing of calorimeters was being undertaken by the Bureau of Standards, Mr. Klumpp asked for the discharge of the Committee. The Institute, however, considered that they had proved too useful servants to dismiss; and they decided to continue them in office. We have received a copy of the report, which occupies 110 pages, and give below an indication of its contents—reserving for a future issue any further notice which may be deemed necessary.

At the outset, the Committee state that the main purpose of the investigation was to study calorimetry with the idea of determining, as far as possible, the factors which influence the accuracy of measurements. These were studied in connection with the use of several of the more important types of calorimeters available. While the tests described by the Committee show some of the characteristics of the different instruments, it is explained that it was not the specific purpose of the report to show their relative merits, or to present it as being complete, and covering all makes of calorimeters in existence. In the previous reports,* results were given of tests made with the Simmance-Abady, Boys, Junkers, and Sargent calorimeters. The results of the last two years' work showed various factors which were not fully recognized in the former tests; and while this did not apparently lead to any erroneous conclusions, the results of the former tests are not strictly comparable with those now presented by the Committee.

In the investigations now reported upon, special attention was given to the calorimeters of the continuous-flow type with independent gas-metering equipment, and also to the newer types of calorimeters recently placed on the market, such as the Doherty, the Parr, and the "Sarco." These three calorimeters embody entirely different methods of construction and operation. During the investigation, many tests were necessary to determine the facts in any one point. At the laboratories of the United Gas Improvement Company at Philadelphia, about two hundred individual test runs were made by Mr. Maurice S. White; while Mr. J. N. Lawrence, at the University of Wisconsin, made nearly a thousand. In addition to the test runs on the individual calorimeters, many tests of the calibration of thermometers, meters, and other accessories were made. The reports of the Committee on their investigations for 1908 and 1909, already referred to, were based on eight hundred individual tests.

Mr. Lawrence has been studying calorimeter problems for two years as a thesis investigation; and his work has been accepted for the degree of Doctor of Philosophy. Since it was carried on under the supervision of one of the members of the Committee, and through their assistance, it is deemed proper to embody this thesis, entitled "Efficiency of Gas Calorimeters," in the report. The investigation was carried out along the lines the Committee considered necessary to determine the problems encountered in their previous tests; to determine the effect of certain atmospheric conditions upon the instrument; and to outline methods of operation which make the results obtained more precise. Many of the results arrived at by Mr. Lawrence were accepted by the Committee, and are shown in detail in their report.

After some introductory remarks, in which the work of previous investigators—Imminkötter at the Technical High School at Aix-la-Chapelle, Kowalke (a member of the Committee) at the University of Wisconsin, and Parr at the University of Illinois—is reviewed, the apparatus employed and the methods of investigation adopted are described. Full details of experiments with all the calorimeters follow; and then come the Committee's conclusions. They say they do not desire to recommend any particular calorimeter, but to present in an entirely impartial manner the facts connected with each instrument. They consider that calorimeters should be operated under predetermined methods, and that the instructions should be strictly followed. Calorimeters measuring the gas by water displacement dispense with the use of a gas-meter, and thereby diminish the errors from this source. It is not supposed that any instrument can be perfect; but the Committee say the designs of some types have approached perfection, so that the results obtained are entirely within the limits of personal error.

It is known that the humidity conditions of the atmosphere introduce a discrepancy in the final readings in some water-jacket types of instruments; but these may, the Committee point out, be corrected within close limits. The corrections to be applied for conditions of humidity are given in a table in the report. In a perfectly efficient calorimeter, with a very high percentage of atmospheric humidity, the products of combustion should leave the instrument at approximately the temperature of the atmosphere. A test of a recording calorimeter not of the water-jacket type was made; and the result obtained demonstrated that the instrument gave continuous readings of the net heating value of the gas that could be relied upon for comparative purposes. But such an instrument must be calibrated from readings made on a calorimeter of the water-jacket type.

In conclusion, the Committee say they feel that the work they have done on testing various instruments has been a means of studying the subject in great detail; and they express the hope that the facts presented in the reports they have made to the Institute will enable the subject to be better understood by individual members, and throw some light on the various factors that are included in measuring the heating value of gas.

* See "JOURNAL," Vol. CIV., p. 904; Vol. CIX., p. 295.

LIQUID FUEL.

By Professor VIVIAN B. LEWES, F.I.C., F.C.S.

[Extracts from the Third, and Concluding, Cantor Lecture before the Royal Society of Arts on Feb. 3.]

Having remarked that he had dealt in his previous lectures with the origin and uses of petroleum and its products, Professor Lewes proceeded to attack the question as to how long the world's supply of petroleum can be expected to last under the enormous draught on it that is taking place.

POSSIBLE DURATION OF SUPPLY.

In 1912, the total weight of crude oil taken from the world's oilfields was between 40 and 50 million tons. Of this, 1·5 million tons, in one form or other, were imported into England—that was to say, one-thirtieth of the world's production was used in the British Isles. From the United States, 980,000 tons were imported; from the Dutch East Indies, 160,000 tons; from Roumania, 144,000 tons; from Russia, 120,000 tons; and from other countries, 96,000 tons. For practical purposes, crude oil might be looked upon as consisting of three fractions—benzine, kerosene, and fuel oil. Regarded in this light, the Dutch East Indies supplied the largest quantity of the benzine oils; America the kerosene, lubricating, and gas oils; while Roumania and America furnished most of the fuel oils.

The lecturer next referred to the effect of the increased demand for oil in the various countries of production on the export trade. At present, America could spare us a fair amount of kerosene and fuel oil; but, in view of the extent to which oil fuel was now being applied in that country, it would not do to rely on this source continuing a cheap market for long. The same might be said of the Russian and other European fields. There were many other sources, however, in which local demand was practically *nil;* and the Dutch West Indies and Burmah fields were of this character. The oil from these fields would naturally go to the best market. Unfortunately, freight (owing to the distance) was high; and the oil ships would be liable to interference in case of war. This led the Professor to suggest that, in order to render our naval position secure, the oilfields of the Empire should be subsidized by the Nation, and everything done to stimulate their rapid development; the Government taking as large a proportion as could be spared of the output, irrespective of immediate demand, and collecting a store in this country of sufficient magnitude to safeguard the naval needs over the longest period that a war would be likely to last.

It was quite evident that, even if the supply of oil continued to increase in practically the ratio shown by the last ten years, the demand would soon get ahead of the supply, and that, owing to our position, it would be only by very careful handling of the commercial side of the question that we should be able to command a sufficiently large share of it to fill our requirements. The important question was, Will the supply continue to increase even at the same rate?

Having quoted from Sir Boverton Redwood's work on "Petroleum" the remarks (made in 1886) of Professor J. P. Lesley, on the question of the duration of oilfields, the lecturer went on to say that all the evidence that they had pointed clearly to the supply of oil from existing fields being less in quantity, and that, however great the output might be, it could last only until the oil from any particular stratum had been exhausted. The keeping up of the world's supply depended on the opening up of new oilfields. While admitting that huge and unsuspected oil areas of which no signs had so far been found might exist, he contended that it was by no means certain that as the present fields became depleted new ones would be opened up with sufficient production to maintain the supply. Dr. Engler had put the period over which oil would be available for the purposes for which it was now used at a hundred years; but he (Professor Lewes) doubted if in

fifty years' time it would be obtainable at a price that would enable it to be employed commercially.

The last century would be distinguished in history as the coal-fuel era; while the use of oil would mark the Twentieth Century, or at any rate the first half of it. Following this, there would probably be a "residues" era, in which the dregs of the coal and oil supply would be utilized, and peat be employed. Then there would be a settling down to the only forms of fuel that would give rapid generation of energy, and wood and alcohol would relegate the power among nations to those which had the greatest growing area at command.

Eking out the Supply.

The lecturer then proceeded to deal with the three fractions of petroleum separately, to see how far the supply could be eked out from other sources to prolong the use of existing liquid fuel. In regard to petrol, he gave some remarkable figures showing the rate of consumption since the advent of the perfecting of the motor car by Daimler. In the eight years from 1903 to 1912, the consumption rose from 18,000,000 gallons to 80,000,000 gallons. This enormous increase in consumption was not confined to England. It has been as great, or even greater, in every civilized country in the world, with the result that the once despised light fraction of crude oil had become the most paying product.

After remarking on the competition of the rival supply companies to secure the English market, and the effect of this on the price, the lecturer turned his attention to the processes which were at hand by which the supply of petrol could be increased from the higher grades of oil which remained after the light fractions had been distilled. In 1865, James Young patented the idea of distilling shale oil under pressure, by which he increased the percentage of light oil; while in 1871 Thorpe and Young showed that, by distilling paraffin wax under a pressure of 25 lbs., liquid products containing some as low as petrol could be obtained. They also established the fact that when a heavy hydrocarbon was decomposed by heat and pressure, a mixture of saturated and unsaturated hydrocarbons of lower boiling point and greater volatility was produced. In 1887, Benton tried still higher pressures, and claimed to be able to produce light oils from any heavy oil residuum; while in 1889 Sir James Dewar and Sir Boverton Redwood patented processes for distilling and condensing under high pressure, which resulted in the heavier grades yielding lighter oils and spirit. Dr. Dvorkovitz had also done much work in this direction. In the refineries at the oilfields it had long been known that by prolonging the period of heating, the fractions of light oil were increased; and the heads or tops of the stills were left unlagged so that the distilling oil might condense and drip back into the retort to undergo a further period of heating. This process of decomposing oil of heavy specific gravity and high boiling point into mixed hydrocarbons of low gravity and boiling point was known as "cracking;" and with the demand for light hydrocarbons such methods deserved all the attention that could be given them.

There was a beautifully arranged works on the Lower Thames where a grade of oil which distilled over after the kerosene had been separated from American oil, and which was very cheap and largely used for enriching water-gas for admixture with coal gas, was employed. This oil, known as "Solar," was sprayed with water into long iron retorts filled with iron turnings kept at a temperature of 600° C.; and the water and oil being volatilized were drawn by the suck of an exhauster through the heated material, where the oil was cracked and the vapours passed through an atmospheric condenser. In this, any heavy or unchanged oil condensed, and was returned to the retort to undergo further cracking; while the light vapours passing forward were condensed in water coolers, and the lightest spirit finally extracted by oil scrubbers—the permanent gases going to a holder and forming the fuel that heated the plant. The condensed and scrubbed-out products were then passed through a continuous steam still, and the spirit distilled from them. The residual oil from this still, together with the condensed oil from the atmospheric condenser, were mixed with fresh solar oil, and went back to the cracking retort or converter. By this method, 100 gallons of solar oil yielded 65 gallons of liquid residuals—39 gallons of petrol, 13 gallons of solvent spirit, and 13 gallons of very excellent varnish.

Another way in which an increase in the petrol supply could be obtained, and which was already being largely used, was to carry on the distillation of the original fraction for light oil beyond the 150° C. which in the past had been the limit, so as to increase the bulk of the petrol at the expense of the kerosene fraction. This could be perfectly well accomplished up to a certain point; and that it was being done was shown by the gradually increasing gravity of the petrol placed upon the market. Great care had, however, to be taken not to exceed certain limits; otherwise the flexibility of the motor was impaired, and troubles arose in starting from cold.

A small addition to our petrol supply could be obtained from the distillation of Scottish shale—an industry located in the Lothians, and which yielded about 600,000 gallons of excellent motor spirit per annum. This, however, was a very small fraction of the 80,000,000 gallons used last year; but there was no doubt that this could be increased considerably with increase in the industry, and also by the employment of cracking processes to augment the spirit fraction at the expense of the lighting oil.

Benzol, or, as it is sometimes termed "benzene," which must in no way be confused with benzine, which had been used as the name for the light fractions of mineral oil, was a product of the destructive distillation of coal; but it was only in large works that it had been extracted from the tar in which it was found, while considerable demand existed for it as the base from which all the coal tar colours were derived.

In the coking of coal for metallurgical work, the recovery plant, in which the benzol and ammonia distilled out from the coal were recovered from the gas before the latter was burnt to supply the heat to carbonize the coal, yielded a far larger proportion of benzol than the gas industry. Some 32,000,000 tons of coal were carbonized annually for coal gas and metallurgical coke; and if proper arrangements for recovering the whole of the benzol from this amount were made, a considerable supply could be assured. Under existing conditions, however, less than half the coal was coked in recovery ovens, and most of the benzol so recovered went abroad.

Having pointed out the possibilities of alcohol as a fuel for motors, Professor Lewes turned his attention to the portion of the crude oil distilling between 150° and 300° C.—the fraction called kerosene. This was the source of the illuminating oils burnt in lamps and used in many forms of internal combustion engines not fitted for the heavier grades of oil. The efforts to increase the yield of petrol were now infringing on this fraction, and in future it was not at all improbable that it would gradually become absorbed by the demand for petrol on the one hand and fuel oil on the other, as it lent itself to both purposes.

Fuel Oil.

Fuel oil, the fraction above 300° C., was not only important as being the form of oil best fitted for naval needs, but was also the source of lubricating oils and vaseline, for which there was a great demand. But as the crude oil contained 50 per cent. of this, and often, as in the case of some Californian and Texas oils, a much higher proportion, the distilling of every available supply to yield petrol must result in enormous volumes being thrown upon the market. Professor Lewes thought the present shortage was due to the fact that the price obtained for it was so far less than that for petrol. All the time that there was a lack of transport facilities, the light spirit was given preference for shipment; but with the great increase in the number of tank steamers, there must be enormous quantities of fuel oil held in stock in many fields which would become available. He fully expected to see a marked drop in fuel oil prices during the next year; but whether the price would ever come down again to the 40s. a ton that would enable the Diesel engine to compete with coal at 18s. per ton in the best steam plant, save for special purposes, was another thing.

Both for steam raising and heavy engine work, shale oil could at any rate help to relieve the demand; but under ordinary conditions of working the grade of oil fitted for this purpose which was yielded by the Lothian distilleries would amount only to 50,000 tons per annum. It was to be hoped, however, that the Government would do everything that could be done to encourage and, if necessary, subsidize the Scotch shale oil industry, as the proximity of the fields to the new naval base at Rosyth would render them an invaluable source of supply; while the unlimited demand for petrol, the possibility of cracking a certain proportion of lighting oil to augment it, and the probable gradual falling off in the lighting oil imported from America, which could not be made up for from Scotland, would all tend to render possible a great increase in the Scotch industry.

The oils obtained from coal, and known as heavy tar-oil, blast-furnace oil, &c., were of a different character to mineral oil, as they contained oxygenated compounds of the nature of creosote and cresylic acid, which not only lowered their fuel value for steam raising, but also gave rise to acrid fumes, which in a closed stokehold were likely to cause smarting eyes and irritation to the throat. By careful grading and distillation, however, oils from coke-ovens, blast-furnaces, and vertical gas-retorts could be used in the Diesel engine by employing 5 per cent. of heavy petroleum oil to act as an ignition oil. The tar from horizontal retorts using light charges of coal and high temperatures, and also from inclined retorts, was, however, useless.

In conclusion, Professor Lewes said that the whole subject of "Liquid Fuel" was so complicated by the many varying factors that bore upon it, that a course of ten times the length would hardly have sufficed to deal with all its ramifications.

Staff Changes in the Gaslight and Coke Company.

The "Co-Partners' Magazine" of the Gaslight and Coke Company for the current month contains an announcement of various staff changes which have lately been made. Consequent upon the death of Mr. J. W. Randell on the 5th ult., as already recorded in the "Journal," Mr. A. H. Solomon has been appointed Resident Engineer at the Fulham station, Mr. A. C. M'Minn to fill a similar position at the Shoreditch and Pancras stations, and Mr. A. A. N. Carpenter at the Bow Common station. Mr. W. H. P. Vowles has been appointed an Assistant-Engineer. The following appointments have been made in the Gas Sales Department: Mr. J. E. Henwood to be First Assistant to the Controller; Mr. R. Willsmer and Mr. H. H. Creasey to be Assistants to the Controller; and Mr. F. L. Butcher to be an Assistant to the Superintendent of the Rental Department (Automatic).

POSSIBILITIES OF HOUSE HEATING BY GAS AS A FUEL.

By A. F. KRIPPNER,

Industrial Engineer of the Laclede Gas Company of St. Louis.

[Extracts from a Paper read before the American Commercial Gas Association.]

THE author explained that the object of his paper was to present the results of experiments, investigations, and observations made under his direction in St. Louis during the heating season of 1911-12. He purposed dealing with the various methods of the application of gas fuel, giving tables based upon carefully collected data, and offering some remarks on the possibilities of the more general use of gas for heating houses and other matters likely to be of interest to the gas industry.

House heating by artificial gas used in a central heating plant is of comparatively recent origin. There are no data at hand by which its beginning can be definitely established; but it is known that for the past few years this method of heating has been employed in a few scattered cases. A couple of plants, each consisting of a battery of manually controlled water-heaters connected in parallel to the heat-distributing system, were installed by the Laclede Gas Company in homes in St. Louis eight years ago; and, notwithstanding the fact that the cost of operation has been somewhat excessive, these plants have given good satisfaction to customers, and have been a source of desirable revenue to the Company. The present state of development in St. Louis may quite correctly be said to have had its most definite beginning in the heating season of 1908-09, for at that time the Company made the first of their thermostatically controlled installations, making it possible to render more nearly the ideal heating service. Subsequent years brought their small quota of house-heating customers, allowing of a more careful and intelligent observation to be made of the practicability of the scheme, so that by the summer of 1911 the efforts in this direction were receiving sufficient support from satisfied customers to warrant a more extensive investigation during the season of 1911-12. This investigation was entered into with the idea of developing the house-heating field as a portion of a broad policy of building up the Company's wholesale business, with particular reference to securing a summer load by offering proper inducements to the large manufacturing industries during the portion of the year when the sales curve shows its greatest depression.

It became apparent at the outset that, in order to assure a more general use of gas for the purpose of heating houses, it would be necessary to determine the best and most economical method of application. The installations utilized for the collection of data consisted of a number of hot-water systems equipped with the various types of heaters available, one coal-burning heater converted to gas by means of burners installed in the fire-box, one hot-air furnace equipped with burners, and one individual gas-radiator system. All the heaters were equipped with pilots and placed under thermostatic control, so that the regulation of the fuel became directly dependent upon the temperature in the house; thus ensuring an economy in operation which cannot be realized in systems manually controlled. Separate meters were placed for all plants, readings were taken daily, any troubles and irregularities were recorded by the man taking the daily readings, and, wherever possible, he made corrections and adjustments while on the premises.

DIFFICULTIES AND THEIR REMOVAL.

A number of difficulties were experienced in the beginning of the season. They consisted chiefly in matters of mechanical detail relative to the proper operation of cut-off valves actuated by the thermostat motor, and the correct drilling, adjusting, and proportioning of burners used in the heaters. Some little experimental work eliminated these obstacles in a very satisfactory manner. The hot-air furnace, however, proved so highly inefficient that some changes were necessary for a greater conservation of heat; and it may be of interest to go into the details of the changes and the resultant operation of this particular system. The installation consisted of two 28-inch furnaces connected as a single unit in a new home built during the summer of 1911. Two concentric ring burners, with mixtures on the outside, controlled by a thermostat and lighted by a pilot, were placed in the fire-box of each furnace. Owing to the inefficiency of the heating plant, as constructed by the manufacturer, it was fully demonstrated in a couple of months that the heating capacity was quite inadequate, while the cost of operation would go far beyond reasonable limits. An economizing device was then installed in an effort to utilize heat that was otherwise lost in the flue gases. This economizer consisted of fifty 2 in. by 2 in. by 66 in. tubes made of galvanized sheet metal sealed into a header at each end, then placed transversely into the cold-air duct leading from outside into the furnace. The flue gas was then conducted from the furnace through the economizer, on the inside of the square tubes, and on to the stack. The ventilation was controlled by a damper placed in the flue-pipe on the chimney side of the economizer. The fuel economy was at once apparent—the consumption in days of equal temperature showing a decrease of from 35 to 40 per cent.; and it was possible to supply sufficient heat to the residence throughout the unusually severe season without providing any additional burner capacity. Temperatures taken at various points of the system showed the following results:

	Deg. Fahr.
Outside air	26
Flue gases leaving furnace	460
Flue gases after passing economizer	160
Fresh air between economizer and furnace	100
Heated air going to the rooms	190

This indicated a drop of 300° Fahr. in the flue gases, and an increase of 74° Fahr. in the incoming fresh air. It shows also that the heated air ready to go to the various rooms was 30° Fahr. higher in temperature than the flue gases after leaving the economizer. Inasmuch as the products of combustion are cooled to a point considerably below 212° Fahr., it is possible, by this method, to utilize the gross heating value of the gas, due to the condensation of the moisture contained in the burnt products. To provide for this condensation, a small pipe was placed in one end of the economizer, and extended to a sewer opening in the floor. In this residence, the more distant rooms were heated by a hot-water system, the heating coils of which were placed inside the hot-air furnace. Because of the intermittent application of heat in the furnace, these coils proved inadequate; and an auxiliary gas-heater, built locally and automatic in its operation, was connected to the hot-water portion of the heating system. The arrangement proved very satisfactory, inasmuch as all distant rooms were kept comfortably heated, quite independent of the hot-air furnaces. It should be borne in mind, however, that the hot-air furnace, though rendered comparatively efficient by the introduction of the economizing device mentioned, offers a rather limited field, due principally to the manner in which it is constructed.

The principle applied to the converted hot-air furnace was then adapted to the hot-water system; the economizer being placed in the cold-water return pipe at some point near the heater. In order to be assured of the exact conditions attendant upon this method of operation, some interesting and valuable facts were determined by a special investigation of thirty days' duration. A copper tube heater, equipped with thermostat, pilot pipe, burners, damper, mercury-seal valve, and copper tube economizer, was placed in a well-built brick house of average size, and recording thermometers were placed as follows: One in the hot-water pipe leaving the heater, one in the water return pipe on the chimney side of the economizer, and one in the flue-pipe on the chimney side of the economizer. The charts taken show the interesting fact that the flue gases can be cooled to a temperature near that of the return water, and to a point considerably below that of the water leaving the heater to go to the radiators. The relation of maximum temperatures was approximately as follows:

	Deg. Fahr.
Water leaving heater	170
Water returning from radiator	120
Flue gases on chimney side of economizer	125 to 130

Here, again the gross heat value of the gas is realized, due to the conservation of the heat of vaporization of the moisture in the flue gases; and it was fully demonstrated that the gaseous portion of the products of combustion, though cooled to a comparatively low temperature, can be successfully eliminated from the appliance without a draught other than that naturally induced by a properly constructed chimney. The rise in temperature of the outgoing water and the flue gases was simultaneous with the lighting of the burners. It was well defined, and followed in about fifteen or twenty minutes by a less sudden rise in the temperature of the return water; thus indicating clearly the time required for circulation through the shortest course in the radiating system.

A table was prepared to show, if possible, the advantages of the economizer over systems of other type. Readings for one full month, taken in different residences, give the following results:

	Gas per Square Foot of Radiation. Cubic Feet.
Hot-water system	109·6
,, ,, ,,	96·7
Hot air with economizer	91·8
Hot-water system	90·7
,, ,, ,,	118·7
,, ,, ,,	87·6
Individual gas-radiators	81·3
Hot-water system	120·5
,, ,, with economizer	76·02

This would clearly indicate the advantage of the economizer over the other systems.

Data Collected and Results Obtained.

With this brief indication of the principal mechanical features, I will now pass on to a review of the data collected and the results they show. As already stated, a record was kept of the daily consumption of each plant. From these records it was possible to determine what may be called the temperature-consumption curves. A curve was constructed for each residence by the following method: The days of equal temperature, ranging from the coldest to the warmest, were grouped, and the average daily consumption determined for each. Then plotting degrees Fahrenheit horizontally and cubic feet of gas per 24 hours vertically, a series of points were obtained approximating a straight line.

The object of the curves is twofold: First of all, they indicate that the quantity of gas required varies directly as the outdoor temperatures; and, secondly, they may be utilized to estimate the quantity of gas required for temperatures other than those for which the curves were actually constructed. The second feature was used in arriving at the estimated consumption for heating during a season of "normal" or average temperature. The necessity for this reduction to a "normal" basis came from the fact that the heating season during 1911-12 in St. Louis was unusually severe. Of the five principal months of the heating season of 1911-12, four of them were considerably colder than the average, while only one was warmer than its normal temperature. Averaging the values, the heating season of seven months of 1911-12 shows a temperature of 39·14° Fahr., while the normal temperature for these same months is 42·71° Fahr.; indicating a difference of 3·57° Fahr. for the seven months. If, however, the months of October and April are neglected, inasmuch as their averages are the same, and the five months from November to April only are taken into account, the difference in temperature becomes 5·2°, instead of 3·57° Fahr. During the days of extreme cold, all the houses heated by gas were kept comfortably warm, while many of the better type which were heated by coal could not be kept at the desired temperature.

In order to make a satisfactory comparison of the various plants, an arbitrary formula was adopted, by which all information might be reduced to a common basis. The square foot of radiation, based on the following formula, was assumed as a unit: Glass area *plus* 1-10th net exposed wall area *plus* 1-300th cubical contents equals the number square feet of radiation. Basement measurements are not included. By this method, the quantity of gas per square foot of radiation per season was readily determined; and it was found for the different residences that the variation of this particular value was not beyond reasonable limits. By using the average consumption per square foot of radiation per "normal" season it becomes a simple matter to estimate the heating cost of any residence or building—necessary allowance being made, of course, for structural conditions and for any local conditions which may be out of the ordinary.

In making the final comparison of the cost of operation of gas against hard coal, all quantities were reduced to a "normal" temperature basis; and with gas at 80 c. per 1000 cubic feet for the first 10,000 cubic feet, and all excess at 50 c. per 1000 cubic feet monthly, it was found that the cost of gas fuel approximated twice that of hard coal at $8 per ton. It is well, perhaps, to state that in all residences, excepting one, the heating plant was located in the basement—thus affording an opportunity for warming that portion of the house, and serving to keep the flooring of the first storey at the proper temperature. In the one residence excepted, the individual gas-radiator system, wherein the burning of the gas occurred within each radiator, was used. The products of combustion were exhausted, at practically room temperature, by means of a constantly operating electric exhaust fan placed in the basement. No provision was made to heat this basement. In another residence, where a similar system was installed later in the heating season, temperature readings taken at various heights in the room indicated a considerable difference in the heating of the regions near floor and ceiling—so much so that small children on the floor were in a comparatively cool atmosphere. A radiator was placed in the cellar so as to obviate this condition; and it is safe to assume from this that heat radiated into the basement is not lost, but, on the other hand, is essential to the health and comfort of the occupants of the house.

Advantages of House Heating by Gas.

House heating by coal gas offers a number of advantages that readily appeal to the customer. Briefly stated, these advantages consist of absolute cleanliness in the house and atmosphere, a uniformly even temperature, automatic control, heat in any quantity and at any time, and freedom from servant troubles. All these advantages are more highly appreciated by the customer than one would at first suppose. One good housewife in whose home some changes in the gas-heating system made necessary the firing of the coal-heater for a few days, complained vigorously of her dissatisfaction with the old method, but reverted promptly to her former condition of contentment on learning that the gas-heater was again in full operation. In another instance, a woman in whose home the system operated well during the past season most highly recommended it because of its automatic control and its absolute cleanliness. One man stated to a friend that it proved more expensive than coal, but that his home had never been so evenly and comfortably heated as during the past winter; and another expressed his willingness to forego the pleasures of his automobile rather than give up his gas-heater. Thus it may be said of gas for house heating that the old adage that "cleanliness is next to impossible" is a misnomer of the past.

Referring now to the possibilities of heating houses with gas, the fact that the Laclede Company will supply, during the 1912-13 season, gas fuel for the heating of about seventy buildings, including residences from the smallest to the largest, a few stores and offices, and a couple of medium-sized factories, leads to the belief that this particular field is worthy of the fullest exploitation. That the opportunity for this class of service to the public is large, is beyond reasonable doubt; and it is an interesting fact that, after it was announced that a special rate would apply to gas used for house heating in St. Louis, approximately 600 inquiries were made at the Company's office during the brief period of three or four weeks. The Press enthusiastically supported the movement; the Smoke Abatement League gave it its hearty approval; architects submitted plans and specifications for information relative to costs for new houses in process of construction; and manufacturers of, and dealers in, house-heating appliances made careful inquiry into the merits of the scheme, and displayed most reassuring interest. From several sources, therefore, came encouragement which, perhaps, had been but little expected; and even though all the obstacles in the way of applying gas for heating houses more generally have not been entirely removed, there is unquestionably a bright illuminating ray of hope to lead us farther into this distinctive departure in the gas industry.

Objections to the System.

It is quite in keeping with the subject under discussion to refer briefly to the excellent report of the Committee on the Utilization of Gas Appliances of the American Gas Institute, submitted at the annual convention in Atlantic City last October. Referring to "Gas Room-Heaters," the Committee state:

> The use of gas for heating rooms grows apace, and, with the gradual reduction in the prices of gas, this use is probably destined to increase until the quantity of gas used for this purpose forms an important item in the total output. The conditions under which gas is used for room heating in this country are such that your Committee believes it is warranted in devoting considerable space to an examination of the principles and methods employed. The heating of residences exclusively by gas, by means of a heater located in the basement, is, at current prices for gas, rendered impracticable by the high cost as compared with heating by coal. This method is practised to a small extent, but not sufficiently, in the opinion of the Committee, to warrant a further discussion at this time.

This peremptory statement at once surrounds one with an atmosphere of grave doubt as to the feasibility of even giving serious consideration to the subject of heating through a central plant, though it is really the most practical and the most hygienic method. Indeed, one who has inquired thoroughly and carefully into the facts as actual operating conditions present them, cannot concur in that portion of the report of the Committee. It is fully conceded that gas at 50 c. per 1000 cubic feet will cost in excess of hard coal, approximately, as near as can now be determined, from 85 to 100 per cent. On first thought, this may appear rather extreme; but it should be remembered that this figure does not take into consideration any of the many costs incident to domestic service, handling coal and ash, the value of cleanliness and personal comfort about the home, and other advantages, all of which can reasonably be reduced to a monetary value. Not so many years ago, illumination by gas, as compared with the cost of coal oil, appeared quite beyond reason; while those who advocated gas for cooking and for domestic water heating at first met with considerable opposition. In all the instances just mentioned, the increased cost of operation by using gas was equally as much, and often more, at variance with the old fuel as gas fuel for house heating is in excess of hard coal. Certainly the added cost of operation cannot be urged against the scheme, for experience does not bear out the argument; and rather than disparage the development of this almost unlimited field, we should seek out the ways and means by which it can profitably be brought within the scope of the commercial progress of the gas industry.

Commercial Aspect of the Question.

Thus far the author has dealt little or not at all with the strictly commercial aspects of the subject in relation to its money-earning capacity for the gas company. No well-managed company or corporation will, or is expected to, plunge hastily into this comparatively new departure of the industry; and one cannot see that there is any necessity for a hasty conclusion either for or against the project, without first subjecting it to a most rigid study and investigation. It cannot be claimed as yet that the entire problem has been fully solved; in fact, only a beginning has been made. During the present heating season, and for two or three in the immediate future, the Company will not become so deeply involved in house heating in St. Louis as to have any appreciable effect upon its manufacturing plant or its distribution system. But the increasing demand for gas for this particular purpose unquestionably points the way to a splendid opportunity for a wholesale outlet for its product; so that it would in reality be a very short-sighted policy not to give judicious consideration to this phase of the question.

As intimated at the beginning, this feature is being viewed in its relation to a policy which has to do with the development of a larger wholesale field; so it is a little early, perhaps, to rigidly estimate its commercial value. There is very little doubt that a

company considering the advisability of assuming a big house-heating load will at the same time look carefully into the possibility of developing a strictly summer load to absorb as nearly as possible the excess manufacturing capacity available because of the winter peak load. Not alone will this condition obtain relative to a wholesale summer load, but the well-informed manager whose view is unimpaired by pride or prejudice must recognize in the gas business the ever-varying and fluctuating conditions as imposed by rigid and relentless competition. For every inroad made by a commodity of some different type, but supplying the same human necessity, there must be a counterbalancing extension of activity by the gas company in order that even in peak-load months the manufacturing plant can be operated at the capacity for which it is designed and constructed. For every city, no doubt, this subject becomes an individual problem; so that it is impossible for one city to formulate a policy which is applicable to every other, though everyone who is at all interested can be of material assistance in discussing and attacking the proposition from every possible angle. As progressive, intelligent gas men, a concerted effort on our part should bring us into the illuminated byways that lead into the fields of wholesale privileges. We should broaden our horizon. The high-pressure gas lamp, the kitchen range, the water-heater, and their kindred appliances, are but the foothills leading up to the mountains of our opportunity. Beyond is a new sky-line—its defiant peaks luring us ever onward and upward to the end that the gas industry will have its superstructure so well reared upon the rock foundation that it will be lasting and enduring for all time.

COKE QUENCHING FOR CHAMBER OVENS.

The following is a translation of an article by Herr WILHELM REUBOLD, dealing with the mechanical quenching of coke from chamber ovens, which appeared in a recent number of the "Journal für Gasbeleuchtung."

Whereas it has been the practice up to the present day with coke-ovens to quench the coke almost exclusively by spraying with a hose, the introduction of chamber ovens with horizontal or slanting chambers in gas-works has called forth a demand for some mechanical means of quenching, to deal with the great amount of hot coke which is discharged in a short space of time. Experience has shown that large quantities of hot coke can only be quenched satisfactorily by immersion. In the system to be described, the coke is first received by a holder, and water is then let in from underneath, so that the cooling water passes in the same direction as the steam which is produced during the process. When the water has reached the top surface of the coke, it is simply run off. It is quite immaterial how the water is brought into contact with the coke. A coke-holder with a pierced bottom is lowered into a water-tank, or a water tank can be raised till the water covers the coke, or, finally, the water can be made to enter the quenching trough below the coke from an overhead tank, and be either pumped back afterwards or allowed to run away. But the important point is that it is quite useless to fill the coke-trough with water and then drop the hot coke in, as only explosions and other unpleasant effects will be produced.

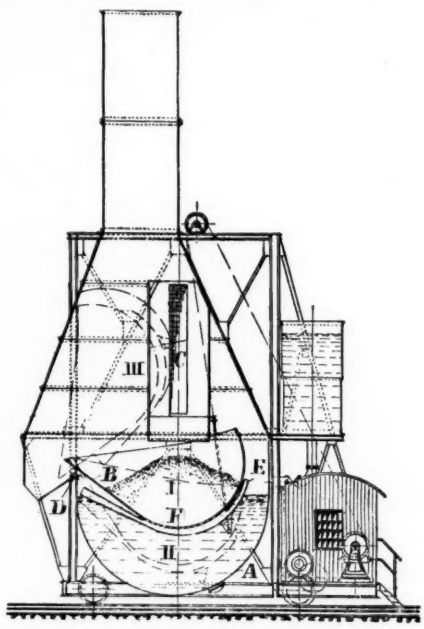


Fig. 1.

Apparatus of the type shown in fig. 1, is already in use; and a simple extension of the system, working on the same principle, will afterwards be described. It was first supplied by the Berlin-Anhaltische Maschinenbau Aktiengesellschaft for the new coke-ovens of the Neumühl Coal Mines. It was designed by Herr Direktor Storl, of Tarnowitz, and the author of this article together, and is patented in Germany. Although it was first supplied for coke-ovens, there is no reason at all why it should not be adopted with great advantage at gas-works.

In the designing of the apparatus, economy in water, electric current, and labour was constantly kept in view. The general idea can best be explained by reference to fig. 1. A water-tank A is arranged on a carriage, and into it dips the holder B, which receives the glowing coke from the chambers C. During the filling, the holder, which is pivoted at D, is held by the raising-chain of the winch in position half immersed in the water, and so it remains cool. When it is full of coke, the winch is released, and, by the weight of the coke, the holder sinks deeper into the water, which runs over the edge E into the water-jacket, and so penetrates to the coke through the perforations shown at F, rising gradually till the top level of the coke is reached. The relative positions of the coke-holder for filling and quenching are shown by I. and II. A flue is provided to carry off the vapours produced. The water lost by evaporation can be replaced in several ways—either from a high tank, or by pumping, or from an ordinary tap.

When the coke is quenched, the holder is raised about the

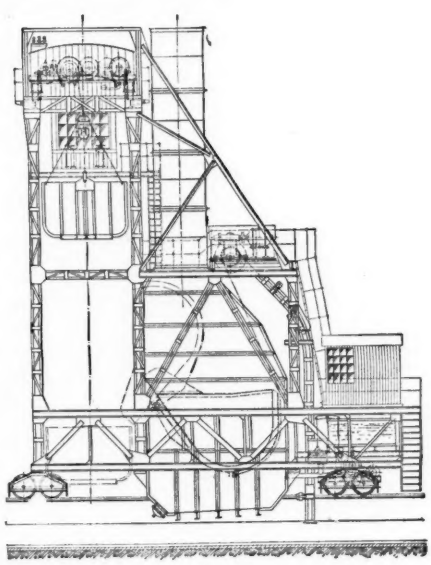


Fig. 2.

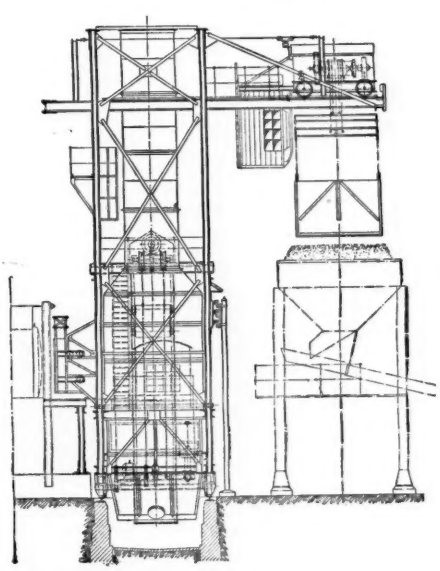


Fig. 3.

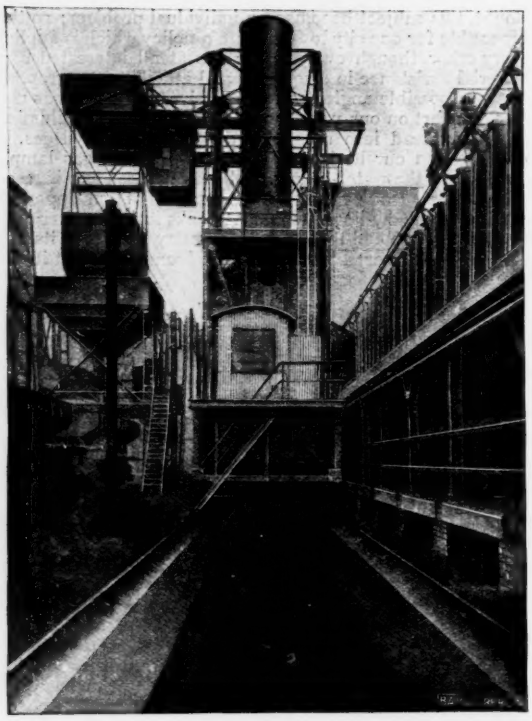


Fig. 4.

pivot D into the tipping position III.; the water running out during the raising at the lower end of the water-jacket. The coke-holder can naturally also be left in any intermediate position, should it be desired. The coke, having been quenched and tipped clear of the apparatus, can be transported by any of the usual means. In this system the water consumption is reduced to a minimum, as it will be seen that actually only the water lost by evaporation during the quenching need be replaced.

In the case of the coke-oven at Neumühl, this quenching apparatus was combined with a travelling crane for handling the coke. This is shown in figs. 2, 3, 4, and 5, and the system affords complete communication between the oven, the store, and the breaking and screening plant. For removing coke from the store, a grab is attached to the projecting arm of the apparatus. For conveying fresh coke from the coking ovens, a bottom-opening hopper is used, which is lowered to receive the coke from the quenching trough. The latter, as also the hopper, are made large enough to receive the whole discharge from one chamber. This discharge—roughly 6 tons—can be quenched and conveyed to the store or the screening plant in under ten minutes.

The consumption of water is practically as small as it can be—only about 55 to 60 per cent. of the weight of coke quenched, which agrees very nearly with the theoretical quantity required to destroy the units of heat present. The water content of the quenched coke is about 3 per cent.; and all pieces, large and small alike, are evenly cooled. Hand-quenched coke generally contains 4 or 5 per cent. of water, and the water required is 100 per cent. of the weight of coke. Moreover, there is no breaking up of the large pieces during the process. A further advantage is the formation of steam directly the water is let in to the coke. This steam passes through the coke, and immediately extinguishes any flames due to tar or incomplete carbonization; and thus smoke nuisances are avoided. The water naturally acquires a certain temperature owing to its being used repeatedly. In practice this is, however, found to be a great advantage, as the coke is not quenched so suddenly, splitting of the large pieces is avoided, and the quenched coke is drier.

The saving in wages is considerable; only six men being needed for sixty ovens, as against twenty-one with the old hand process. Of considerable importance also is the economy in space which is effected by the use of this apparatus.

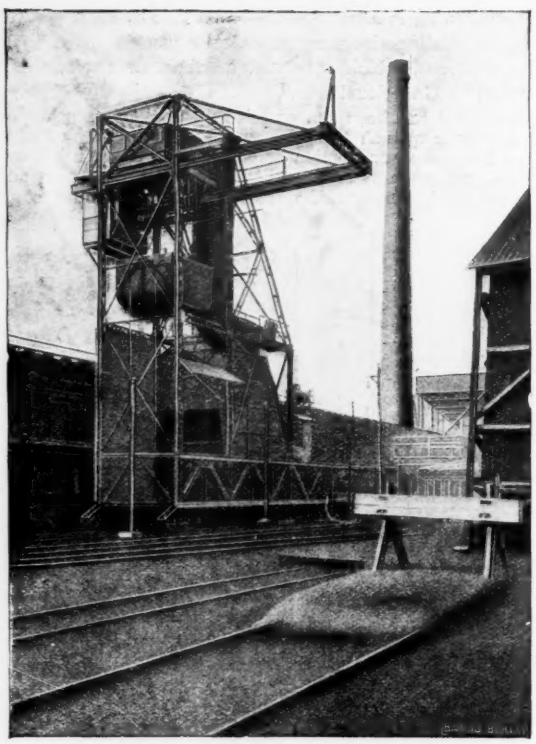


Fig. 5.

NEW METHOD OF USING FURNACE SLAG.

A communication on this subject by Herr O. Mohr appeared recently in the "Chemiker Zeitung." The following is a translation of the abstract of the article that was published in the "Journal für Gasbeleuchtung."

In large works the removal of furnace slag forms an item of considerable expense. It is not in all cases possible to use it for building purposes or to throw it away; and generally much more is produced than can be used up. However good the plant is, there always remain in the slag considerable quantities of combustible material—under the best conditions 20 per cent., and in less favourable circumstances even as much as 70 per cent. The author reckons that, of the 140 million tons of coal which are used in the German Empire, 50 to 60 million tons are consumed in such furnace plants, which leaves a residue of some 6 to 8 million tons to be disposed of in some way or other. This residue contains at least 2 to 3 million tons of combustible material, which up to the present has been completely lost. A new process, patented by A. F. Müller, makes possible a division of the slag into two parts—that rich in carbon and that which is not—by the difference in specific gravity of the two kinds. The process consists in introducing the slag into a liquid, the specific gravity of which is little higher than that of carbon. The parts rich in carbon float on the surface of this liquid, whereas the purely mineral portions which are rich in silicate sink to the bottom. By altering the specific gravity, it is quite easy to regulate the quality of the parts that separate out.

A test made by this method with 2000 tons of furnace residue gave 8 tons of coke ($\frac{1}{8}$ inch to 2 inches) with a calorific value of about 25,000 B.Th.U.; 470 tons of breeze ($\frac{1}{4}$ inch to $\frac{1}{2}$ inch) with a calorific value of 18,500 B.Th.U.; and 650 tons of coke dust with a calorific value of 10,500 B.Th.U. The coke and breeze can be burned directly; the dust and the breeze (if desired) can be worked up very well for briquettes. The residue after the separation of this coke can also be better employed than it has been hitherto. From it can be manufactured concrete bricks and light stones for building.

Complaints of an Electric Light Installation.

A report presented to the Newquay District Council by the Surveyor last Tuesday stated that during the past year complaint had been made of 1537 failures of electric lamps in the streets; the hours' lighting lost being 6148. On the basis of the contract with the Electric Lighting Company, he calculated that £7 was due to the Council for unlit lamps. Mr. Vivian said this failure of the lamps to give light was a serious matter. They did not want money from the Company; what they did want was that the town should be properly lighted. They expected the lamps to be fully lit each night. Mr. Gerry agreed that light was the important thing, and said he did not think any amount the Company might offer would be sufficient to compensate for the loss. Mr. Bond remarked that the Gas Company were now able to supply lights which would stand any wind; and the Council should consider whether it would not be desirable to go back to that Company when the present contract with the Electric Lighting Company expired. Mr. Westlake said it was no doubt true that the Gas Company were in a better position to compete with the other Company than they were five years ago. It would be in the interest of the town to appoint a small Committee to approach them, and see whether they would be prepared to treat with the Council. They ought to arrange for much more satisfactory lighting than they now had. This suggestion was adopted; and it was decided for the Council to also interview the Electric Lighting Company as to the improvement of the light.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Interest by the Way.

SIR,—Walking in one of the suburbs of London the other day, I came across a large number of new middle-class houses on an estate the development of which commenced, I understand, about a year ago. It was early afternoon; and therefore broad daylight. One of the houses had outside a notice-board inviting inspection. To my astonishment, I saw that the house was lighted throughout, and through the windows red silk and other ornamental shades were visible, making the house look very attractive—so attractive that I was tempted inside; and probably the same cause that induced me to enter was the one that induced the other visitors whom I saw inspecting the place during my brief visit.

From top to bottom, the house had been piped by the gas company, and fitted as a house should be for good and ornamental lighting, and for saving labour and obtaining convenience and comfort by gas heating. Inverted lamps, of the "Metro." type, were everywhere; and the character of the fittings, glassware, and shades was in keeping with the spruce and decorative character of this modern designed house for middle-class occupation. In the front part of the hall, there was a lamp with ornamental glass-sided shade. At the back part of the hall, there was a lamp, with an inverted conical glass shade of the prismatic type, which allows a portion of the light to pass upwards to the ceiling. This light illuminated all the entrances to the ground floor rooms at the back part of the premises as well as the stairs. It at once struck me that it was most conveniently placed; and I was prepared to find other evidence that whoever had been responsible for locating the fittings in this house knew the art of his business, and was not a slave to the traditions of his forefathers in the matters of the selection and placing of gas lights. Switches were handily situated for lighting and extinguishing the lamps. In the dining-room, was a central shaded light; the fitting being a bronzed one of the "Surprise" pendant pattern. There were side lights, too—all alight. In the fire place, giving out a cheerful heat, and burning noiselessly, was a handsome gas-fire. In the drawing-room there was a light and pretty three-lamp pendant beautifully fitted, and two side brackets. A gas-fire was also burning here. In the kitchen and scullery were inverted lights with opal shades; and these are places where good lighting is, for the sake of cleanliness, very necessary, but often unprovided. A gas-oven and a gas-copper were fitted in the scullery; and the kitchen is therefore kept quite clear for the ordinary culinary operations. Ascending to the bedrooms, the landings were found fitted with inverted lights, of a size sufficient for the purpose. The burners throughout the house, in fact, are all of a size conformable with requirement. The best bedrooms were fitted with gas-fires; and all were well lighted. In the first bedroom, there were found two side brackets—and not where wind-disturbed curtains could come into contact with them. A fitting depending from the ceiling carries a burner in front of the position where it is expected the dressing-table will be placed in order to obtain a maximum of natural light in the daytime.

I was pleased with the whole fitting up of the house for lighting—suitable fittings, burners, and positions—as well as with the illustration of the use of gas for heating and cooking. The gas company's advertisement must be of considerable assistance to the landlord in rendering his houses additionally inviting. The house was completely decorated, but not furnished. The comfortable lighting and heating tempted one to make a thorough inspection. There was no one to interfere with the inspection; no gas man to canvass the visitor for his custom. What was there was left to tell its own tale. Card announcements were found here and there expressing the willingness of the gas company to be of service to the tenants of the houses. From each gas-fitting was suspended a neat ticket, with the price of the fitting, burner, and shades or glassware separately marked in plain figures; and the total stated at the foot of the little sum. Nothing was overdone—not even the prices; but everything was attractive and tempting. It went to show the visitor how about 75 per cent. of the inconvenience of "being without a servant" (which is a common experience in the houses of the middle class) is knocked on the head by gas, the ever-ready servant.

Reflecting upon the advertisement in this new house, I must say the whole thing was well done. The saying that," if a thing is worth doing at all, it is worth doing well," is ancient, but the truth of it is not one whit depreciated on this account. The house has been, and will be, visited out of pure curiosity by many people resident in the neighbourhood; and by them modern gas lighting, decorative and useful fittings, and the gas means of heating and labour-saving will be seen, and when seen cannot fail to be admired.

I am not in any way connected with the gas company referred to in this letter. It was quite by chance I saw the house. Before I came to it, I had been debating in my mind which of two roads I should take—this or another. Interest was found in the one selected. Certain I am, Sir, that this cannot be "The Sleepy-Headed Gas Company" that provoked grievance in a builder, and caused him not long since to pour his tale into your ears. My object, however, in writing is not so much to praise the company responsible for what they have done here, and probably have done at many other places, but to suggest this method of cultivating business and knowledge as one worth emulating by other gas concerns who have not adopted it as part of their business boosting system.

PEDESTRIAN.

Feb. 5, 1913.

Public Health (Acquisition of Water) Bill.

SIR,—I heartily welcome the letter from Mr. Badham published in the last issue of the "JOURNAL," which explains the scope of the above Bill more fully than my letter published the previous week. If Parliament is too busily absorbed with party politics to deal with useful administrative measures, there is all the more reason for such measures to be discussed by experts to whom they are of vital importance. While I may claim to have advanced the engineers' case for the Bill, Mr. Badham has most usefully added the criticisms which his experience as a Parliamentary Agent entitle him to advance with great authority.

Let me say at once, in expressing my sympathy with the main purpose of the Bill—that is, the granting of powers to rural councils to obtain water rights, as well as land, compulsorily—I by no means intended to support the Bill in the exact form in which it was drafted. It seemed to me obvious that, in the normal course of the Bill through Committee, opportunity would have arisen for the points urged by Mr. Badham to be fully considered, and for the Bill to be, if necessary, amended. While I am anxious that further powers should be conferred on rural councils, or other local authorities (if any), to whom additional facilities in regard to water supply are likely to prove a public advantage, I am quite in agreement with Mr. Badham when he urges that these additional powers should not include any modification of the existing provisions protecting the interests of water companies or of the owners of land and riparian rights.

Our Private Bill Procedure has so far been characterized by a full and proper recognition of private rights; and although cases may occur in which private rights are nevertheless improperly interfered with, these are the exception rather than the rule, and no one can reasonably urge that private rights should be disregarded even in the public interest.

The Water Supplies Protection Bill, to which Mr. Badham refers, unquestionably went too far in the opposite direction, and gave undue prominence to private interests as against public interests. But it would certainly be contrary to the policy adopted by the Institution of Water Engineers in connection with the Bill, and quite contrary to my own desires, if, in conferring necessary additional powers upon local authorities, Parliament placed it within their power to unduly interfere with, or to expropriate without proper compensation, the rights of private individuals or public companies.

At the same time, I cannot admit that because a Bill contains undesirable provisions, it must be denied consideration; and I still regret that the Bill under discussion was not advanced sufficiently to enable its bad points to be eliminated, and its good points to be incorporated in an Act of Parliament.

PERCY GRIFFITH, M.Inst.C.E., &c.

20, Victoria Street, Westminster, S.W., Feb. 7, 1913.

National Health Insurance Act, Part II.—Attention is called by Mr. R. W. Edwards, of Aldershot, to a correction in decision No. 373, which appeared in "Board of Trade Journal" for July 11. This should read: The Umpire has decided that contributions are not payable in respect of workmen engaged in the work of repair of blast-furnaces, lime and brick kilns, gas-retorts, retort-settings, or chemical or electrolytic plant (other than machinery or buildings).

Lighting Burnley's Back Streets.

At the meeting of the Burnley Town Council last Wednesday, the minutes of the Gas Committee (which were approved) contained a report by Mr. J. P. Leather (the Gas Engineer) in reference to unlighted back streets. The report stated that there are in the borough 435 back streets which are not lighted. Of these, 163 might be lighted from lamps placed in a main street opposite the end of the court. The remainder, if required to be lighted efficiently, will need a lamp, or in some cases more than one, to be placed in the back street itself, thus necessitating a longer service. A service laid up a back street is more costly than in the footpath of the main street, as the paving costs more to re-instate. The capital expenditure per lamp in the case of the 163 streets would be from £4 10s. to £7 10s., according to the distance from the existing mains. In most of these cases, however, the distance is small, and the average cost might be taken as £5 per lamp. In the whole of the 272 other places, the length of service required is much greater, and the cost, including re-instatement of paving, would vary from £14 upwards. The total capital expenditure for lighting all the back streets would therefore be about £5000. The annual cost, at £2 10s. per lamp, would be £1087, which is equal to a rate of about ⅝d. in the pound. The Committee decided that the time had arrived when the Corporation should light back streets throughout the borough, and that, subject to the approval of the Council, after hearing the report of the General Purposes Committee thereon, the Town Clerk be directed to apply to the Local Government Board for sanction to a loan of £5000 for the purpose.

Reduction in Price at Staveley.—The Staveley Parish Council have received an intimation from the Gas Company of their intention to reduce the price of gas from 4s. 5d. to 4s. per 1000 cubic feet for street lighting and household purposes.

High-Pressure Gas Lighting at Guildford.—In connection with the reference in last Tuesday's "JOURNAL" (p. 337) to the installation of high-pressure gas lighting in two of the principal streets of Guildford, it may be stated that the steel mains which were laid by the Gas Company for the purpose are the Mannesmann weldless steel spigot and faucet tubes, with rigid joints, which are now used in the majority of the high-pressure systems of the country.

Newport (Mon.) Rates and Municipal Trading.—It is stated that, owing to the expenditure in connection with the Electricity and Tramways Committee's undertakings, there will be a large increase in the Newport (Mon.) rates. At present, the addition to the existing rate which will be necessary is said to be 6d. in the pound; but the Finance Committee hope before the subject comes before the Town Council to be able, owing to the alteration in the scale of all the assessments and the allowances, to reduce this by 2d., which will mean a net increase of 4d.

REGISTER OF PATENTS.

Manufacture of Artificial Fuel.

GRAIGOLA MERTHYR COMPANY, LIMITED, YEO, F. C., and GOSKAR, T. A., of Swansea.

No. 29,220; Dec. 28, 1911.

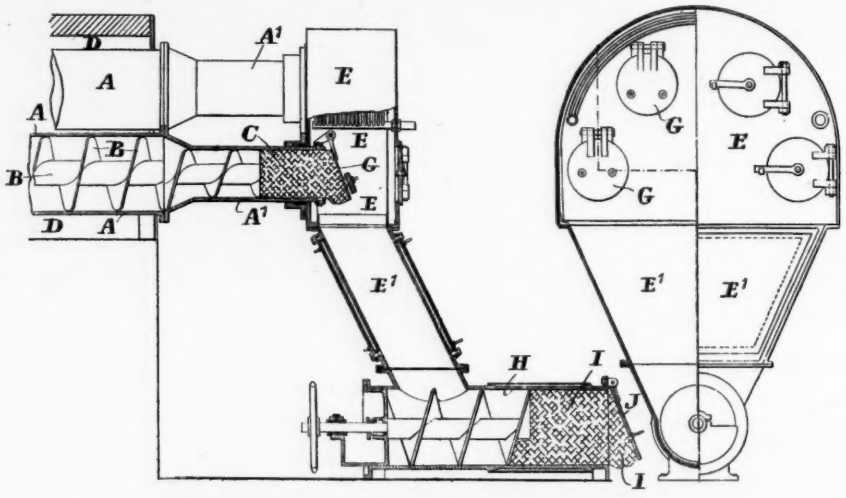
This invention relates to apparatus for the manufacture of artificial or patent fuel wherein the fuel components are heated and mixed in a closed retort or chamber so as to prevent the escape of volatiles or vapours during the heating and mixing; and the patentees describe the invention as carried into practice in conjunction with the process and apparatus for manufacturing artificial fuel described in patent No. 23,555 of 1909, patent No. 6853 of 1896, or patent No. 7905 of 1900.

A special object of the invention is to retain as far as practicable by condensation, before the mixture comes in contact with the outer air, "those gases, vapours, or volatiles which experience has proved add appreciably to the calorific value of the fuel."

The illustration shows a longitudinal vertical section of the exit end of a set of retorts showing the arrangement of the special cooling chamber in conjunction therewith, and an end view, half in exterior elevation and half in sectional elevation.

A is the gas-tight heating chamber or retort employed, with an Archimedean screw B mounted as described in patent No. 23,555 of 1909—*e.g.*, having an Archimedean screw or worm conveyor B which is supported by bearings at one end only, while the other end (or the entire length) of the screw or worm traversing the retort rests on the inner wall of the latter. At this last-named end of the screw or worm it may be reduced in diameter, or otherwise arranged as to be adapted —acting in conjunction with the walls of the retort—to compress the heated fuel mixture into a solid core or plug C formed only of fuel material and of sufficient density to resist the internal gas pressure arising inside the retort. At or towards the exit end A^1 of the retort, the latter may be reduced in diameter or otherwise specially formed so as to act in conjunction with the screw or worm to form the plug or body C of compressed fuel therein.

The exit end of the retort is outside the furnace or heat zone D; and, furthermore, the exit end of the retort may be provided with means to cool it—as, for example, it may be water jacketed so as to exert a



Apparatus for Treating Coal for the Production of Artificial Fuel.

preliminary cooling action on the fuel before the latter enters the special cooling chamber E E^1 provided according to this invention.

Moreover, the exit end of the retort may be of any suitable shape—as, for example, of flattened form, and provided with an expansible or spring controlled cover on the top or on one or more sides; and the expansible cover may be located in the water-jacket or under the water in the jacket—after the manner described in patent No. 23,555 of 1909.

The exit end of the retort thus constructed is arranged in gas-tight connection with the special cooling apparatus E, which latter may advantageously comprise, as described, an inclined chamber E^1 (having ample internal capacity) through which the broken up fuel will freely pass, either by gravity alone, or means may be provided inside the cooling chamber to cause the material to pass through the chamber. The chamber may be cooled in any suitable manner—for example, by an external water-jacket and a system of internal water-cooling pipes or coils or equivalent. From the lower end of this special cooling chamber the fuel material may be passed to the outside atmosphere by any suitable means, such as a fuel plug forming device.

At the extreme end of the heating chamber or retort where the compressed fuel material emerges into the upper part of the special cooling chamber E E^1, in addition to the means to cause or assist in the compressing of the fuel mixture into a plug C in the exit end of the retort, any suitable means may be provided to assist in breaking up the thus temporarily compressed fuel mixture as it emerges from the end of the retort—as, for example, a hinged flap G adjustably weighted (such as is shown at the entering end of the retort in patent No. 23,555 of 1909) may be employed for this purpose.

The bottom of the inclined part of the special cooling chamber leads the fuel mixture (by means of a gas-tight connection) into the horizontal tubular chamber H, which may be water jacketed exteriorly and provided interiorly with the short Archimedean screw whereby the now sufficiently cooled fuel material (with the condensed gases or vapours) is again temporarily compressed into a more or less solid body or plug I, which is sufficiently solid as to be adapted to prevent the escape through it of any gases or vapours from the chamber E E^1; and this plug I, as it emerges from the cooling chamber exit H, is then broken up again by the weighted flap J, after which this partially cooled and now broken-up fuel material may be subjected (as described in patent No. 23,555 of 1909) to a further and final cooling action in the air, and then pressed into blocks or briquettes in a suitable press.

Distillation and Purification of Crude Coal Tar, &c.

BARBET, E. A., of Paris.

No. 27,005; Dec. 2, 1911. Convention date, Dec. 3, 1910.

This invention relates to apparatus comprising a single rectifying column, provided with a still or boiler heated by direct fire, and containing the usual plates and caps; the column being divided into a number of zones by the interposition of internal tubular condensers, "for the purpose of effecting such a degree of partial condensation of the ascending vapours that the condensate descends through the plates of the column and is boiled again, so that any light constituents contained therein are evaporated—leaving at each zone, to be subsequently drawn off, in a liquid state, spirits, petroleums, or oils which are perfectly homogeneous as regards volatility."

The patentee remarks that it has hitherto been proposed to separate and extract from benzines and other liquids (by fractional distillation) the several liquids having different boiling points, by means of apparatus comprising a single distilling column containing the usual trays and caps; but above the caps of each tray a hood is provided, whereby, when the benzine vapours ascend the column, they undergo successive partial condensation upon the underside of the hoods—the condensed liquids being collected directly by gutters provided, one on each hood —and are led away through suitable pipes; the condensing being effected by the downflow of the liquid from one tray to an adjacent one below, in such a manner that the liquid is distributed over the hoods. Should, however, the ascending vapours not be sufficiently cooled, then a portion of the liquid on one tray is cooled in an outer chamber by the circulation of cold water, the temperature of which is not regulated before being discharged on to the hood of the tray immediately below. Such apparatus is of very complicated construction; and, moreover, the fractional distillates are not rectified, and cannot therefore be homogeneous.

The present invention is, moreover, characterized by the combination of the improved rectifying apparatus with auxiliary boilers for the purpose of obtaining continuous distillation "by carrying on to a very great extent the extraction of heavy oils, and by a particular combination for the distillation of the tars and the extraction of the naphthalene."

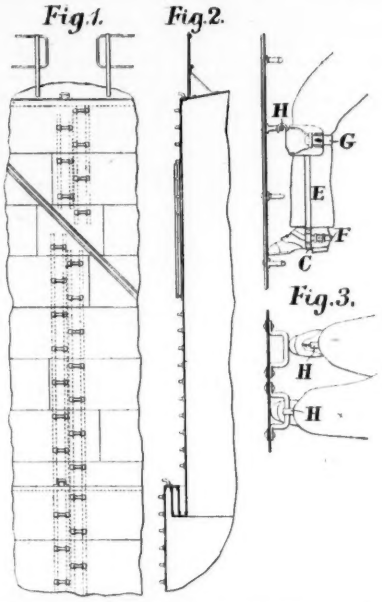
Providing Access to the Crown of a Gasholder.

MILBOURNE, R. J., and COTTRELL, W., of Muxton, near Newport, Salop.

No. 8607; April 11, 1912.

The inventors propose to provide upon the sides of the holder a number of clips, handles, or the like, securely fixed to the side sheets and spaced at suitable distances apart (preferably in zig-zag manner). In conjunction with the clips or handles are devices designed to be attached to the legs of the person desirous of obtaining access to the crown of the holder. The device comprises a stirrup into which the foot of the wearer is to be placed, and which is an extension of the lower end of a bar designed to be securely attached to the leg of the wearer—preferably through the medium of two straps arranged to be passed around the wearer's leg—one just below the ankle, and the other immediately beneath the knee-joint. The bar at its upper end, which terminates at about the level of the knee-cap, is bent outwardly and downwardly, so as to form a hook, or the upper end may carry a hook secured to it. With this arrangement, a person "can easily and safely ascend a holder by causing the hooks upon the device to engage

with the zig-zag clips or handles attached to the sides of the holder; the clips immediately above those in engagement with the hooks being used as handles by means of which the wearer can rise, so as to bring the hooks into engagement with the next clip or handle."



Milbourne and Cottrell's Gasholder Climbing Plant.

Fig. 1 is a side elevation of a portion of a holder provided with the clips referred to. Fig. 2 is a side view. Fig. 3 is a side view and plan illustrating the leg stirrup in engagement with one of the clips on the holder.

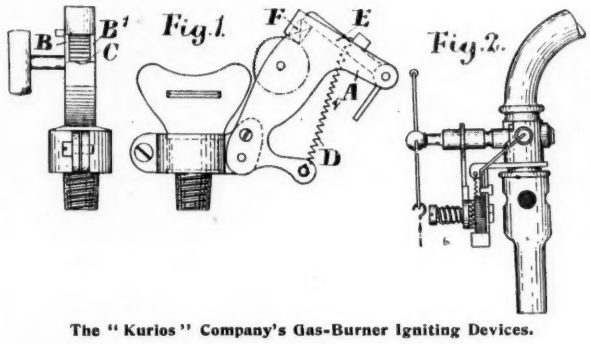
The stirrup C, into which the foot of a person who wishes to ascend to the crown of the holder is inserted, is an extension of the lower end of the bar E. F is the strap by which the lower part of the bar E is secured to the foot of the wearer; the strap passing around the foot just below the ankle. G is the second strap by means of which the upper part of the bar is secured to the wearer's leg just below the knee-joint. H is the hook which is a continuation of the upper end of the bar E, and is formed by the bar being bent outwardly and downwardly.

Igniting Devices for Gas-Burners.

HADDAN, R.; a communication from the Société Anonyme des Etablissements "Kurios," of Geneva.

No. 4916; Feb. 27, 1912.

This invention relates to improvements in igniting devices which, when released, rotate friction wheels (mounted in a casing attached to the burner) against rods of ferro-cerium or other pyrophoric material adapted to produce a spark.



The "Kurios" Company's Gas-Burner Igniting Devices.

Fig. 1 is an end and side elevation of one form of construction. Fig. 2 shows a construction adapted for inverted gas-burners.

The device fig. 1 comprises a cage A formed of two lateral plates B and B¹ between which is an abrading wheel C mounted on a spindle traversing the plates, and a lever E pivoted between extensions of the plates. The spindle is provided at one end with a button intended to put in movement the wheel C, which contacts with, and supports, a rod F of pyrophoric material (ferro-cerium) upon which bears the lever E, which is under the action of a spring D held at one end by a lug bent up from the lever, and at its opposite end by a pin projecting from an extension of the plate B¹. The lever E is connected to an arm, by exerting pressure on which, in the direction of the wheel C, the lever can be readily raised when the ferro-cerium rod is worn away sufficiently to require replacement.

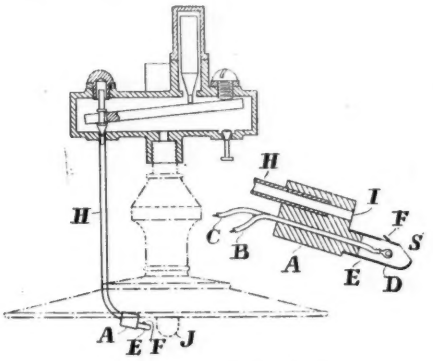
Fig. 2 illustrates a device more particularly applicable to a burner of the inverted type. Here the gas-cock is opened or closed by a double lever attached to its outer-end actuated by chains connected to its ends.

Igniting Gas-Burners.

KEITH, J. & G., of Farringdon Avenue, E.C.

No. 8260; March 16, 1912.

This electric ignition device for gas-lamps is intended more particularly to be used in conjunction with the electrically operated valve-controlling means described in patent No. 6517 of 1912, where an auxiliary supply of gas passes into and through a chamber containing a filament joined to electric conductors.



Keith's Gas-Burner Igniter.

The illustration shows a gas-lamp provided with valve controlling means of the type referred to and equipped with the improved electric ignition device; also a detail of the ignition device itself.

The ignition device includes a small insulating body A, which carries two conductors B C joined by a platinum filament D, which is protected by a metallic cover E forming a chamber and having a small adjustable louvre-piece F. The body is slipped on a tube H, serving to lead an auxiliary supply of gas to an outlet I, from which a jet of gas is directed towards the mantle J. The louvre-piece is so adjusted as to catch a small portion of the jet issuing from the outlet I and divert it into the interior of the chamber afforded by the cover E, where it is ignited at the filament D—the flame issuing through an opening S in the end of the chamber and igniting the jet issuing from the outlet I. In this way, "a fairly large jet may be ignited without risk of cooling the filament by the rush of gas."

The device is so arranged that should the auxiliary valve not close tightly when it is intended to be shut off, with the main burner alight, any small flame burning at the outlet I will curl upwards and not cause damage to the filament D.

Coking or Gas Ovens.

SOCIÉTÉ ANONYME BURKHEISER-ELOY, of Liége, Belgium.

No. 16,225; July 11, 1912. Convention date, July 13, 1911.

This invention relates to coke-ovens, gas-ovens, and the like having horizontal retort-chambers and heating flues formed between vertical walls, which contain the gas and air supply channels leading to a number of combustion openings one above another in the heating flues. It is already known, the patentees remark, to arrange for the gas to be burnt at as many combustion openings as possible, one above another, in the vertical heating flues; so that the heating of the ovens may be evenly distributed. The partition walls of the heating flues have been used frequently for enclosing the supply channels for the gas and air for combustion; but in such cases the products of combustion have not been carried away through the opposite partition walls. On the other hand also, the walls have been utilized for taking away the burnt gases; but then the gas and air for combustion were introduced into the flues either from the top or bottom.

According to the present invention, the gas and the air for combustion are introducod through channels in the even numbered partition walls; while the burnt gases are carried away through channels in the odd numbered walls, or *vice versâ*. In this way, the passages for the burnt gases in the walls may be made as short as possible, and consequently "very effective equalization of the heating is secured."

Retorts for Coal-Gas Manufacture.

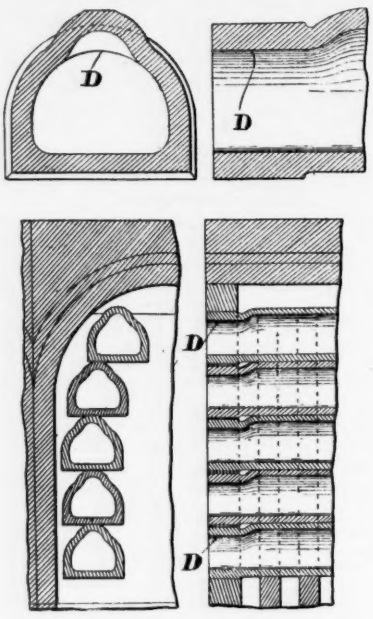
HUNT, P. C. H., and TIPPER, F. J., of Melbourne.

No. 12,675; May 29, 1912. Convention date, Sept. 16, 1911.

In the introduction to their specification, the patentees say: It has been found that the best all-round results are obtained from the coal when the retort is filled with coal; but in the course of practice it is not always possible to completely fill the retort without jambing the coal in places closely against the roof of the retort. And when this occurs, there is not a sufficiently free space for the gas to make its way to the ascension pipe, and, consequently, undue pressure is formed in the retort. Moreover, where short retorts are used in small settings, the convenience of removing at intervals from the roof of the retort carbon which accumulates thereon is a matter of considerable importance. Further, in the construction of retorts for the distillation of gas from coal—whether the individual retorts have been arranged horizontally or at an incline—it has generally been the practice to provide a line of brickwork between two superimposed retorts, although it has heretofore been proposed in certain cases to dispense with such brickwork by providing on the exterior of the roof of the individual retorts at intervals transverse ribs having flat surfaces, on which corresponding surfaces on the underside of the superimposed retort are adapted to lie.

The present invention relates to an "improved retort" designed to

meet the objections mentioned. To this end the retort is formed for a short distance at the charging end of the same shape as the cast-iron mouthpiece; while the roof portion for the remainder of its length is raised and so shaped internally that when the retort is charged there is a conduit or gas-way between the coal being treated and the inner side of the raised portion of the roof.



Hunt and Tipper's Coal Gas Retorts.

The illustration shows a cross-section and a part longitudinal section of such a retort; also an arrangement of such retorts in one form of suitable setting.

The centre portion of the roof of the retort is raised to a height of about 3 inches above the usual level of the roof line at D, if the retort were made in the ordinary way. The external portion of this raised portion is made flat, so that the retort placed above it in the setting may "rest accurately and conveniently on it."

The raised portion forms a way for the gas as distilled from the coal to find an easy passage to the ascension pipe without having to pass through coal. It is said that such a retort "can be thoroughly filled by modern charging machinery so that the charge of coal occupies the full section of the retort below the raised portion and that this can be performed without difficulty."

Each of the retorts when arranged in settings can be made to conveniently rest on the next lower one—thus avoiding the necessity of a layer of brickwork between the two. The section of retort shown renders it specially suitable, it is said, for the carbonization of coal in heavy charges (and for use in combination with charging machines). "When so used, it entirely obviates the necessity of having two ascension pipes for one through retort in settings, and further that both in single and in through settings a better seating of the retorts can be obtained."

The passage above the line at D, it is claimed also, prevents carbon from depositing in an even layer, and greatly facilitates the removal of any carbon deposited on the roof of the retort.

Recording Mechanism for Meters.

HALL, C. I., of Chicago, U.S.A.

No. 16,800; Jan. 3, 1912.

This invention relates to recording mechanism in which the extent of the operation for any desired time intervals of mechanism having cyclic operation is recorded at the end of such intervals; the recording operation serving also to automatically re-set the recording mechanism so that each record will indicate only the extent of the operation for the period terminated by the recording operation. The meter-indicating mechanism is unrestrained in its forward movement by any device tending to move it in the opposite direction, and is automatically re-set to zero position at the end of the predetermined time intervals by the recording operation.

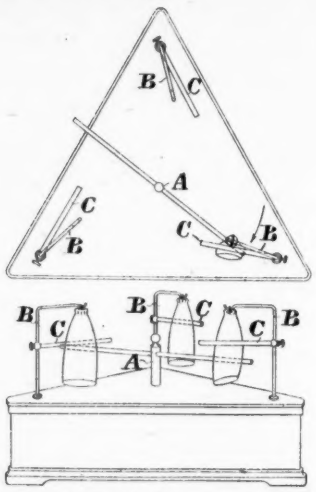
In the particular embodiment of the invention shown in the specification, the patentee illustrates the recording mechanism as printing devices adapted to be advanced to represent the added or total actuation of an electric meter during intervals determined by time-controlled mechanism, as a result of which a record is made at the end of each interval of the amount of actuation of the meter during such interval, and the printing devices are re-set to zero automatically by the printing operation, as a result of which each record thus printed indicates the rate at which electricity is consumed during a certain period in watts (or some quantity proportional thereto), as determined by the meter. Instead, however, of controlling the intervals between recording operations by means of a time-controlled mechanism, the intervals may be determined arbitrarily by an operator, if desired, since the closure of the electric circuit (or gas supply pipe) serves to cause the printing operation, and this may be effected either manually or by time-controlled devices, such as clockwork, as desired.

Demonstrating the Strength of Incandescent Gas-Mantles.

BRUNO, W., of Berlin.

No. 19,736; April 29, 1912.

This apparatus has been devised for the purpose of demonstrating the strength, as regards flexibility, of incandescent gas-mantles for upright burners after they have been burnt off. It consists of a number of L-shaped standards on which the mantles are suspended; of a number of arms which are slowly rotated by a spring or other motor and are adapted to bear with the outer ends against the lower parts of the suspended mantles; and of a number of rods secured to the L-shaped supports above the plane in which the rotating arms revolve, and adapted to be adjusted on the supports so as to vary the position and the degree of the bending to which the mantles are subjected during the rotation of the revolving arms.



Bruno's Mantle-Testing Machine.

A plan of the apparatus is given; also a perspective view. In use, the triangular case shown contains the motor to revolve a vertical shaft A which projects above the case. The mantles are suspended from the upper limbs of the supports B, and are "burnt off." The rods C are then clamped in position on the vertical limbs—one rod being at a certain height and in a particular angular position, a second rod at another height and in another (or the same) angular position, and so on according to requirements. The motor is then started, and, as the arms revolve, the lower parts of the suspended mantles are deflected and flexed against the rods C to degrees depending on the vertical and angular positions of the rods.

Gas-Lamps—Silica Chimneys.

KEITH, J. & G., of Farringdon Avenue, E.C.

No. 1348; Jan. 17, 1912. No. 3388; Feb. 10, 1912. No. 12,196; May 23, 1912.

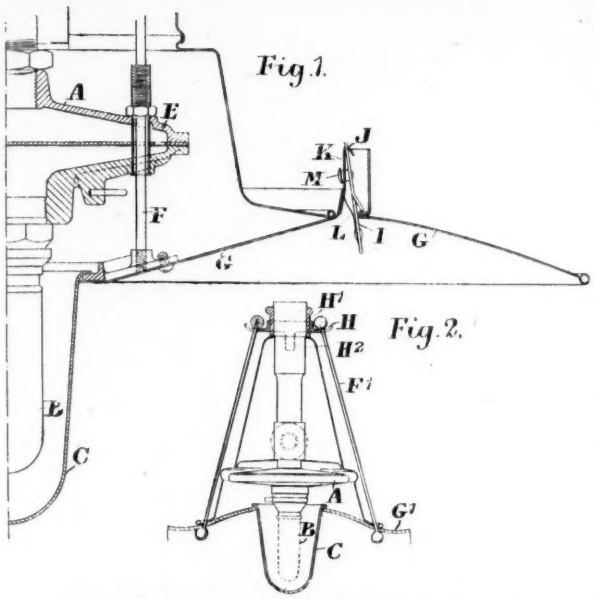
This combined invention relates to improvements in high-pressure inverted incandescent gas-lamps in which air is introduced under pressure or a mixture is introduced under pressure as described in patent No. 28,360 of 1907.

In this prior construction both primary and secondary air was made use of; but suggestions have been made, the patentees remark, for "dispensing with secondary air in high-pressure inverted incandescent gas-lamps, and though some measure of success has been obtained by the use of primary air alone, the highest efficiency has not been reached owing to want of knowledge of the best conditions." They find that when primary air alone is used in high-pressure inverted incandescent gas-lamps, the globe should quite closely surround the mantle. Ordinary glass globes present difficulties, owing to their liability to fusion. The inventors therefore form their globes of fused silica, "the use of which has been already suggested as a support or cover for mantles of ordinary low-pressure incandescent lamps." The gas or air mixture or the air supply is heated, and the mixture led downwardly under pressure into a chamber of small dimensions—being practically closed against ingress of the surrounding atmosphere, so as to ensure exclusion of secondary air. In this way, owing to the concentration of the heat in the neighbourhood of the mantle, a "maximum lighting effect is obtained;" while, on account of the resistance to the downward passage of the flame offered by the globe, "it is possible to employ with advantage a mantle of more open texture than heretofore."

The general construction of the metallic part of the lamp is similar to that described in the prior patent; the lamp being fitted with a heater A for the gas and air mixture, or with a heater for the primary air. The mantle B is surrounded by a small transparent cylinder or globe C of a mean diameter which it is found from experimental research may vary from one and a half times to thrice the mean diameter of the mantle, but which, by preference, is of the smaller diameter. The cylinder has a closed bottom, excluding secondary air, so that the mantle is immersed in a very hot atmosphere; the bottom of the globe being spaced from the bottom of the mantle a distance which may approximate to the distance between the vertical sides of the globe and the vertical sides of the mantle. The cylinder G is shown of conoidal form—*i.e.*, tapered at its lower end. This conoidal shape, though not essential, gives the best results.

In a lamp constructed as described, owing to the small amount of

clearance between the cylinder and the sides of the mantle, there would ordinarily be considerable liability of the mantle being damaged in the act of opening or closing the lamp. To obviate this drawback, devices are provided for guiding the cylinder vertically in such a way as to prevent damage to the mantle, and which also act as hangers when the cylinder is lowered, so that the cylinder need not be touched by the hand—"which latter is an important consideration, inasmuch as the mere handling of a fused quartz cylinder by the bare fingers creates a deposit on the surface of the cylinder, which, when heated, is converted into an opaque body and so obscures the light."



Keith's High-Pressure Inverted Incandescent Lamp.

For example, in fig. 1, the patentees lead through vertical tubes E, fitted to the heater A, two or more vertical rods F, attached to a reflector body G having a central aperture into which the cylinder C is dropped; the outer portion of the reflector body being supported by catches, each of which may comprise a flat strip I in hinge-like engagement with a bent portion J of a strip K secured to the inner portion of the reflector. A spring L tending to move the strip I outwardly is provided; while a rivet M, or the like, passes through the strip K and is secured to the strip I serving to support the catch—the arrangement being such that when the outer portion of the reflector is moved upwardly each strip I is sprung outwardly to engage the inner rim of the reflector, as in fig. 1, which may then be secured in position.

Alternatively, as in fig. 2, two or more rods or wires F^1 attached to a reflector body G^1 may be fitted to slide through guide holes in the body of the lamp and be held in raised position by engagement with a forked member H adapted to be raised and lowered by rotation of a sleeve H^1 in screw-threaded engagement with the forked member H and abutting at its lower end against the upper end of the lamp body, so as to tension the rods and hold the reflector hard up against the lamp body.

LEGAL INTELLIGENCE.

THE LIVERPOOL CORPORATION ASSESSMENT APPEAL.

Appellants Liable for "Beneficial Occupation."

On Monday last week, the judgment of the House of Lords was given in the appeal by the Corporation of Liverpool against an order of the Court of Appeal, confirming a decision of a Divisional Court, in an action between the Corporation and the Assessment Committee of the Chorley Union and the Overseers of Withnell in respect of the rating of the reservoirs at Rivington. The Corporation acquired 12,000 acres of land in the township of Withnell; most of it being moorland, with a few farmhouses scattered about. These were done away with in order to diminish risk of pollution to water, which flowed by natural gravitation from this area into the water-works. About 300 acres of the land was planted with young trees, and the sporting rights were let. The Corporation admitted a liability to be rated to the poor as to their occupation of these 300 acres, and the sporting tenant paid rates in respect of his sporting rights; but they denied beneficial occupation of the whole area. The Court of Quarter Sessions upheld the contention of the Corporation; but both the Divisional Court and the Court of Appeal were of opinion that the Corporation were liable. The arguments for the appellants were heard towards the close of last year, as reported in the "JOURNAL" at the time. At their conclusion, their Lordships said they did not desire to hear Counsel for the respondents, and would consider their decision.

The Counsel in the case were: For the appellants, Mr. Balfour Browne, K.C., Mr. Macmorran, K.C., and Mr. Oulton; for the respondents, Mr. Danckwerts, K.C., Mr. Walter Ryde, K.C., and Mr. Gordon Hewart, K.C.

The Lord Chancellor said he had had an opportunity of reading the judgment which Lord Atkinson was about to deliver, and he entirely agreed with it.

Lord Atkinson read a long judgment, at the close of which he said he was clearly of opinion that each of the uses to which the appellants devoted the moorland—*i.e.*, the commercial use of collecting for them water which they in their business vended, as well also as its use as a game preserve—and certainly these two uses combined, were sufficient to turn the appellants' admitted possession of the land into beneficial occupation of it, so as to render them rateable in respect of it. For these reasons, he thought the Court of Appeal was right.

The appeal was therefore dismissed, with costs.

CLAIM FOR INFRINGEMENT OF BURNER PATENT.

HIGH COURT OF JUSTICE—CHANCERY DIVISION.—Monday, Feb. 3.

(*Before Mr. Justice* NEVILLE.)

New Inverted Incandescent Gas-Lamp Company, Limited, v. Howlett and Co.

This was an action in which plaintiffs claimed an injunction to restrain defendants from making, using, or offering for sale articles made in accordance with an invention, the subject matter of patent No. 5769 of 1900,* granted to Josef Bernt and Emanuel Cervenka, which patent was now vested by assignment in the plaintiff Company, and from making, using, selling, or offering for sale articles differing only colourably from this invention, and from in any way infringing plaintiffs' patent. Plaintiffs also claimed damages, and delivery up or destruction of the infringing burners. Defendants denied that they had infringed or threatened to do so. The plaintiff Company are grantees by assignment dated Nov. 12, 1902, and duly registered at the Patent Office, of the patent in respect of improvements in, or relating to, gas-burners. It was alleged that defendants had infringed by making burners constructed in accordance with the invention and embodying the plaintiffs' patented arrangement.

Mr. A. J. WALTER, K.C., and Mr. GORDON appeared for the plaintiffs; and Mr. T. TERRELL, K.C., and Mr. GRAY represented the defendants.

Professor *Vivian B. Lewes* and Mr. *C. G. Brett*, a manufacturer of gas appliances, gave evidence in support of the plaintiffs' case.

Mr. TERRELL, in opening the defence, said the only question for the Court was, what was the construction of the plaintiffs' specification? The evidence merely went to this: If you use insulating material you infringe; if you do not, you do not. The patent had been construed by the Courts in actions brought by the plaintiff Company against the Globe Light Company and Cope and Timmins; and on each occasion the Court had held that the patent did not bear the construction contended for, as the real object of the specification was to prevent striking-back. Having called attention to the judgment of Mr. Justice Joyce, and the Court of Appeal, he contended that the present action was one of a series of attempts in some way or other to capture the sole right to inverted burners.

Tuesday, Feb. 4.

Mr. *James Swinburne* having this morning given evidence for the defendants,

HIS LORDSHIP said the only question seemed to him to be whether defendants' burner was colourably different from the plaintiffs'.

Mr. TERRELL said he could point out many differences.

Mr. WALTER, in reply, said the only question to be decided was whether in fact defendants had made a colourable imitation of plaintiffs' apparatus. He thought it could not be denied that defendants had sailed as near as possible to plaintiffs, in order to obtain the benefit of cooling as described in the specification.

HIS LORDSHIP said the case resolved itself into an extremely small compass. Defendants' apparatus was constructed primarily with a view to getting a reduction of heating in the inside gases, which was the object of plaintiffs' specification. Reading this specification, he thought defendants were entitled to use an isolator of any thickness they chose to employ. Plaintiffs had claimed the combination; and one of the essential parts was a deflector to prevent the flame striking-back. The question was, had the defendants got this deflector, or something which only colourably differed from it. The element of plaintiffs' invention was wanting in defendants' apparatus, and, consequently, there was no infringement. The result was that the action must be dismissed with costs.

[In regard to the proceedings reported above, it is only right to point out that the action had, of course, no reference whatever to the New Inverted Company's later patent—No. 24,815 of 1905—under which their most improved and standard types of burners are being made.—ED. J.G.L.]

* An abstract of the patent specification appeared in the "JOURNAL" for June 12, 1900, p. 1556.—ED. J.G.L.

The Charge against a Former Gas Company's Secretary.—At the Bow Street Police Court on Friday last, Robert Henry Rushforth, Solicitor and Clerk to the Justices at Amersham, was charged, on remand, before Mr. Curtis Bennett, with forging and uttering receipts in connection with the Amersham Gas Company, of which he was the Liquidator. The case for the prosecution was concluded at the last hearing [see *ante*, p. 261], and the prisoner was now committed for trial; the same bail as before being allowed.

THE GASLIGHT AND COKE COMPANY.

The Half-Yearly Ordinary General Meeting of Proprietors was held last Friday, at the Chief Office, Horseferry Road, Westminster—Sir CORBET WOODALL, M.Inst.C.E., D.Sc. (the Governor), in the chair.

The SECRETARY (Mr. Henry Rayner) read the notice convening the meeting, the seal of the Company was affixed to the "Register of Proprietors," and the report and accounts were taken as read.

THE GOVERNOR'S SPEECH.

The GOVERNOR: We have to review this morning a half year which has been more than usually interesting. Not for seventeen years have we shown so large an increase in the sale of gas, and yet we are obliged to draw upon the balance accumulated in former years to provide for our dividend.

THE FIGURES IN THE ACCOUNTS.

I think it will be well that I first explain the figures of the accounts—reserving until afterwards such observations as are called for upon the position of the Company. The amount spent on capital account has been £112,800, against which the credits for depreciation, &c., are £60,850—leaving a net addition to expenditure of £51,950. We have made no addition to the called-up capital for eleven years. Consequently these half-yearly sums involve no immediate increase in the charge for dividend. They simply reduce the balance of capital unspent, which stands now at £368,000. So long as we can meet the costs of a growing business without issuing additional stock or debentures, the charge for dividend per unit of gas sold must decrease. In the year 1903 this charge stood at 12·36d. per 1000 cubic feet sold, and for the past year at slightly under 11d. This is a very important item; the difference representing some £156,000 per annum. If allowance be made for the increase in the rate of ordinary dividend paid—viz., from £4 8s. to £4 17s. 4d. per cent., or, including the amount contributed to the redemption fund, £5 1s. 4d. per cent. per annum—the reduction in the charge for capital represents £232,000 per annum.

THE REVENUE FIGURES.

While considering the revenue account, it must be borne in mind that the income from gas sold is less in comparison with the same half of 1911 by £53,000, due to the reduction in price made at the commencement of 1912. The increase, which would at equal prices have been £117,000, was, on this account, actually £64,000. Upon rents for meters, stoves, and fittings, there is a gain of £28,000—most gratifying evidence of the growth of our business. Residual products, coke, tar, &c., yielded an increase of £102,000, of which £64,000 is attributable to the larger quantity of coal carbonized, and £38,000 to better prices. These three groups of items—gas, rents, and residuals—together give an improved revenue of £194,000. On the other side, coal cost £188,000 more, cancelling the whole of our gain from the added sale of 7¼ per cent., or 920 millions of cubic feet of gas—a quantity which, as the "JOURNAL OF GAS LIGHTING" pointed out last Tuesday, means the entire supply of such an area as Edinburgh and Leith combined. Delays in the delivery of oil caused a precautionary reduction in the quantity of carburetted water-gas made; and the charge for oil and coke was consequently reduced by £11,000.

IMPROVEMENT IN MANUFACTURING PLANT.

The conversion of our older manufacturing plant, which has already yielded excellent results, was continued, and, because of the great improvement in the demand for gas, accelerated—hence the increase in the charge for repairs and renewals of works of £48,000. So, also, the increasing favour in which cooking and heating by gas is held, represented by the addition within the year of 60,000 stoves and fires, has swollen the costs of distribution by a like amount (£48,000). These charges for repairs and renewals will be high for some years to come, but will not in future show increases so large as in the period under review.

CO-PARTNERSHIP AND INSURANCE.

The only other points I need dwell upon are the addition of £4000 to the co-partnership bonus, and the appearance for the first time of the Company's contribution under the National Insurance Act, amounting to £3828. The "Approved Society" formed under the Act numbers 10,000 of the Company's employees.

A LESSENED BALANCE CARRIED FORWARD.

Summing up the debtor and creditor sides of the revenue account, we have had to meet extra outlay of £276,000, towards which the added revenue from all sources has yielded £194,000; the difference being an adverse balance of £82,000, as compared with December, 1911. Deducting the surplus earned in the corresponding half year (£26,000), the reduction in our balance carried forward is £56,000, which just about equals the reduction in the price of gas made at the beginning of last year.

THE ELASTICITY OF THE BUSINESS.

I hope that the figures I have put before you explain the financial position, and satisfy you that, while the burden upon the half year has been heavy, the results show how elastic our business is, and how capable of meeting very severe strain. Under the circumstances described, the Directors have pleasure in recommending the payment of the same dividends as last half year, which will give upon the ordinary stock £4 17s. 4d. per cent., costing £399,452, and leave £712,387 to be carried forward.

PRICES OF GAS AND COAL.

There will be no reduction in the price of gas this year. The prospect is grave in the matter of coal; but I know that all classes in the service of the Company will do all that in them lies to avert the grave necessity for raising the price of gas. Little practical good can, I fear, result from any observations of mine upon the position of the coal supplies; yet the question is one of such vast importance to our own and other industries that it cannot be passed without comment. The Legislature insists upon elaborate precautions to safeguard gas consumers. Not only is the gas in London tested day and night, and in many different places, to ensure that its quality and quantity are well maintained, but the accounts of the companies are examined minutely by a Government Auditor and his staff, so as to ensure that the price of gas is kept as low as possible. Of all this, we make no complaint. Is it not, however, an anomaly that, while so much is demanded of us, the suppliers of coal—the material absolutely necessary to the life of our business—are under no obligations or limitations whatever to the public? The national coal strike of March last involved serious inconvenience and loss to the owners, as well as to the whole community; but this was slight in comparison with what has happened since.

WHY NOT A TAX ON EXPORTED COAL?

Speaking on this subject a year ago, I expressed the hope that the Government would, in the event of a general strike, re-impose a duty on exported coal, because "by this means the difficulty of re-starting factories and workshops caused by the exhaustion of stocks of fuel would be to some extent lightened." What happened was that so soon as the pits were re-opened, there was a great and legitimate effort made to meet the foreign demand, and home industries were delayed and put to additional heavy costs on this account. Further, stocks were brought so low that manufacturers, afraid of a possible renewal of the trouble, strove to refill their stores, and so the demand exceeded the supply, and prices advanced far beyond what a reasonable profit *plus* an extra charge for wages justified; and these prices will be maintained probably until the period of splendid trade now obtaining meets with a serious check. It seems to me that our statesmen and our professional instructors in political economy (who, I suppose, ought to be regarded as the guides of the public opinion which sooner or later crystallizes into laws) have not given proper attention to the commercial side of the question of our national coal supply. We have been lectured to respecting the probable duration of the supply, and all sorts of guesses have been made as to what we shall do when the stock of coal is exhausted. These speculations leave me cold. What I am concerned about is the apathy, the heedlessness, which leaves all users of coal in England, under certain recurring circumstances, at the mercy of a class (small in number, but great in influence) so situated as to be able to make the commodity as dear as suits its purpose. I am not presuming to blame any individuals for doing the best they can for themselves. We all do the same. What I do wish, however, is that, failing the development of some form of agreement between owners and users, the Government would seriously consider the causes which bring about the repeated and enormous rises in the price of coal, and the difficulties experienced by users generally, and gas companies in particular, in obtaining supplies.

GOOD PROSPECTS FOR THE COMPANY.

I have but a few words to add. The report tells you that the Company's steamship is doing well. Phenomenally bad weather and disturbances among transport workers were a hindrance; but she is proving a profitable investment. Co-partnership continues to prosper. The men's savings grow apace, and there are evidences of increased and intelligent interest in the Company's prosperity. The manufacturing results have been good, reflecting credit upon Engineers and workmen alike. Co-partnership is entitled to some of the credit for this.

THIS YEAR'S CELEBRATIONS.

This is the Jubilee Year of the Institution of Gas Engineers, and that Institution, together with the Society of British Gas Industries, are promoting an exhibition of gas appliances on a scale and plan not hitherto attempted. This will be held in London in October next; and your Directors are taking an active part in promoting its success.

OFFICIAL CHANGES.

I have to report with sincere regret that Mr. Alfred Bevis has retired from the office of Chief Accountant after a service of forty-four years with the Company. To speak of Mr. Bevis's services in adequate terms, without appearing to exaggerate, is difficult. I will only say that never did an officer better deserve his retiring allowance, nor carry with him upon leaving greater regard and esteem on the part of Directors and officers alike. Mr. W. Blakey, our new Accountant, has had the advantage of serving a long apprenticeship under Mr. Bevis, and will, we believe, prove a worthy successor. Our engineering staff suffers a sad loss in the sudden death, recently, of Mr. J. W. Randell, the Resident Engineer of the Company's Fulham works. The Directors desire to record their appreciation of services well rendered by him during a long life devoted to the Company's interests. Like the late Mr. Iago, Mr. Randell continued the performance of his duties until within a few hours of his death. I have further to express the regret of the Directors at the retirement of Mr. J. J. Walker from the position of one of the Company's Auditors, which office he has held for the past thirteen years. His resignation was due to ill-health, which adds to our regret. Mr. Walker had been connected with the gas industry for sixty-four years, having been appointed an officer of the late Imperial Gas Company in 1849.

ADOPTION OF THE REPORT AND ACCOUNTS.

With these remarks, I have pleasure in moving—

> "That this meeting do agree with and confirm the report of the Directors and the Auditors' report and statement of the accounts of the Company as transmitted to the proprietors on the 30th ult."

But, before putting the resolution to the meeting, I shall be happy to hear any remarks which proprietors may wish to make, and I will endeavour to answer any questions they may ask.

The DEPUTY-GOVERNOR (Mr. Ulick J. Burke) seconded the motion.

SHAREHOLDERS' REMARKS.

Mr. F. H. PILLEY said he rose on this particularly happy occasion to most sincerely congratulate the Governor upon his well-earned,

though long deferred, title. The Governor had done wonders for the Company; and if some of the old shareholders would only compare this meeting with the meetings which took place many years ago, they would really feel that there was one man who—of course, with the assistance of all those working with him—had initiated and brought about such reforms as had placed the Company into a very happy state. He had known the Governor for between 49 and 50 years; and he had always found him a most courteous gentleman under all circumstances. Sir Corbet Woodall was a man he had followed. He was noted throughout for his extreme courtesy by men from the very top of the tree to the stokers and all about the place—and he had always a kind word for all. The meeting would, he thought, be with him in offering to the Governor their very sincere congratulations.

Mr. E. KIMBER said the Governor had in his opening remarks referred to the unfortunate delay in the delivery of oil. He thought this was exceedingly unfortunate, because, on looking at the accounts, it appeared there had been a great diminution in the consumption of oil in the manufacture of gas. This half year they had consumed only 5,000,000 gallons, as compared with 8,000,000 gallons in the previous half year. They could, however, congratulate themselves that, owing to the improved carbonizing, there had been an increase in the quantity of gas made, because, while during the previous half year they obtained 10,000 cubic feet from a ton of coal, this year they got 12,000 cubic feet per ton. So far as appeared from the accounts, the cost of oil worked out to 30s. a ton; and he thought it might be obtained for less if only they had their own tank-ships. The cost of coal worked out to 14s. a ton; and he agreed with the Governor that they had now come to a very serious pass, because he very much doubted whether they would ever get coal for less—though, of course, he hoped they would. It seemed to him that the course of events lately had been disastrous to all gas companies; and the chances were that, when once the persons interested against gas companies had obtained their high prices, it would be exceedingly difficult to bring them down. Therefore, their only hope was to get oil; and he trusted there would be no further delay in its delivery. He quite understood that their difficulties were the same as those of other large consumers of petrol. But one thing was certain—namely, that the users had not looked ahead as they should have done. The great thing was for large consumers to have their own tank-steamers; and he knew of one large company who had commenced to get together a fleet of steamers, one of which would be launched next week. This would be the largest tank-steamer in the world—15,000 tons. He only hoped the Company would get three or four such steamers of 10,000 tons, and then they would have something to fight with to decrease the price of coal, or at any rate they would prevent it from rising.

Mr. F. W. BRUCE asked whether the increased cost of coal was due to increased price or increased tonnage?

The GOVERNOR: To both.

Mr. BRUCE said they had a large sum invested, and he would be glad if the Governor would tell them the amounts of the various holdings, or have the information printed in detail in future half-yearly reports.

THE GOVERNOR'S REPLY.

The GOVERNOR: If there are no further observations made or questions asked, I will put the resolution. In doing so, I may take the opportunity of thanking Mr. Pilley, which I do very heartily, for his kind words, and you all for the hearty way in which you have received them. I take it that the honour which has been done me has been an honour to the industry that, to a certain extent, I represent, rather than to myself as an individual. With regard to the supply of oil, it is, as Mr. Kimber, will admit, a little difficult to control the elements; but, after waiting three months without oil being delivered, we have had three ships, and we are now flooded with oil for a time. The construction of a tank-steamer is certainly not at the present time an investment that we are prepared to face. It must be borne in mind that while we value carburetted water gas very much indeed as a supplement to coal-gas making, the former would be a very poor substitute for the latter. If we are not working water gas in conjunction with coal gas, the cost of it would be too high for us to supply. With regard to our investments, I have a list here, and I see no reason why it should not be published if the proprietors wish it.

A PROPRIETOR: It would be of no advantage to the Company.

The GOVERNOR: No, I do not see any advantage in it. A large proportion of our funds is invested in our own works, and I think they cannot be better invested. Our investments in outside securities are: In 2½ per cent. Consolidated Stock, £221,000; 3 per cent. India Stock, £107,000; 3½ per cent. India Stock, £1500; Exchequer Bonds, £148,000; New Zealand bonds, £50,000; Great Western Railway debentures, £51,000; London and North-Western Railway debentures, £117,000; London and South-Western Railway debentures, £25,000; and in Metropolitan Water Board Stock, £25,000. I think the list is a satisfactory one. [Hear, hear.] From my experience, the more we are able to work our savings in our own business, the better it is for us, because there is no more profitable use to which we could put them.

The resolution was carried unanimously.

THE DIVIDEND.

The GOVERNOR: I will ask the Secretary to read the minute as to the dividends for the past half year.

The SECRETARY then read the Directors' minute of Jan. 20:

(1) That the sum of £15,000 be set aside out of the divisible profits of the Company for the half year ending on the 31st day of December last towards the redemption fund, in accordance with the provisions of the Company's Act of 1903.

(2) That a dividend as follows for such half year be declared—viz.:

On the 4 per cent. consolidated preference stock, at the rate of £4 per cent. per annum.

On the 3½ per cent. maximum stock, at the rate of £3 10s. per cent. per annum.

On the ordinary stock, at the rate of £4 17s. 4d. per cent. per annum.

Subject to deduction of income-tax.

The GOVERNOR: I beg leave to move the adoption of these recommendations, and that the dividends as set out in the resolution be approved.

The DEPUTY-GOVERNOR seconded the resolution, which was carried unanimously.

RE-ELECTION OF DIRECTORS AND AUDITOR.

The GOVERNOR: I have now great pleasure in proposing the re-election of Mr. Ulick John Burke, the Deputy-Governor, as a Director.

Mr. JOHN MILES seconded the resolution, which was carried unanimously.

Mr. BURKE returned thanks for his re-election.

The GOVERNOR: I have also much pleasure of proposing the re-election of Mr. Herbert Jameson Waterlow, who retires by rotation, and who is eligible for re-election.

The DEPUTY-GOVERNOR seconded; and the resolution was carried unanimously.

Mr. H. J. WATERLOW thanked the Board and the proprietors for his re-election.

The GOVERNOR: The next business is the election of Auditors, which must be done on your side of the table. Mr. J. A. Stoneham is eligible for re-election, and he offers himself. As you have seen in the report, the only candidate for the second place is Mr. Percy Howard Ashworth. He has been acting with us for some seven or eight years as assistant to the Auditors, and he is fully competent to fill the place.

Mr. A. BEVIS proposed the re-election of Mr. J. A. Stoneham.

Mr. J. REESON seconded; and the resolution was carried unanimously.

ELECTION OF A NEW AUDITOR.

Mr. BEVIS then proposed the election of Mr. P. H. Ashworth as an Auditor. He was a chartered accountant and a member of an important firm of chartered accountants, had had practical experience for thirty years, and had also been acting as Assistant-Auditor of the Company for the last seven years. He thought it would be in the recollection of the proprietors that Mr. Ashworth had put up as a candidate seven years ago, and that he then kindly withdrew in favour of Mr. Stoneham, because the latter had acted as Assistant-Auditor and knew more about the Company and its accounts than he did.

Mr. G. E. P. HODGE having seconded,

The GOVERNOR said that, with a testimonial such as they had heard from Mr. Bevis—than whom nobody had better opportunities of judging Mr. Ashworth's worth—he had pleasure in putting the motion to the meeting.

The motion was carried unanimously.

SALE OF LAND.

The GOVERNOR: The Directors have to apply for authority to dispose of a very small strip of the Company's land at Kensal Green, required by the Great Western Railway for the purposes of widening the Ladbroke Grove Road Bridge crossing their line. The area of this little plot is only 2¾ perches; but in all cases of sale of land it is necessary to obtain the formal sanction of the proprietors. I beg to move the resolution the terms of which the Secretary will now read.

The SECRETARY then read the resolution as to sale of land.

The DEPUTY-GOVERNOR seconded; and the resolution was carried unanimously.

The GOVERNOR; Ladies and gentlemen, this concludes the business of the meeting. I am very glad to have seen so large a number of our proprietors here to-day.

VOTES OF THANKS.

Mr. REGINALD NEVILLE, M.P., said before the meeting broke up he would propose a hearty vote of thanks to the Governor for presiding and to the Board of Directors for the excellent report and the care they had taken of the property throughout the year. He felt sure he was voicing the feeling of every one of the proprietors in moving this hearty vote of thanks.

The resolution was seconded and carried unanimously.

The GOVERNOR: On behalf of my colleagues and myself, I thank you most cordially for this vote. Before I sit down, I know it will meet your wishes if I propose that our best thanks be also given to the officers and employees of the Company. [Hear, hear.] We are well served; and I have no hesitation in saying so. I am sure that the stress which will be caused by the present position of our supplies will be met by every effort that can be possibly put forward by our officers and staff generally.

The vote was carried unanimously.

Mr. D. MILNE WATSON (the General Manager) thanked the Governor, the Directors, and the proprietors for their vote of thanks, which he assured them he very greatly appreciated. They might rest assured that the officers and men would do their best to prevent the necessity of raising the price of gas, if only the coalowners would be reasonable.

TOTTENHAM AND EDMONTON GAS COMPANY.

The Half-Yearly Meeting of the Proprietors was held last Saturday, at the Company's Offices, High Road, Tottenham—Sir CORBET WOODALL presiding.

The SECRETARY (Mr. E. Topley) read the notice convening the meeting; and the Directors' report and the statement of accounts were taken as read.

PROFIT DISTRIBUTION AND A QUARTER OF A MILLION EXPENDITURE ON NEW WORKS.

The CHAIRMAN said he was glad to be able to again present a report and statement of accounts which could not but be regarded as satisfactory. Although the Company had felt to some extent the burden of higher charges for coal, and had been supplying gas at a lower price than during the corresponding half of 1911, the Directors were able to add £1000 to the insurance fund, £2000 to the renewal fund, pay full statutory dividends, and increase by some £1500 the sum carried forward. Although the accounts were so clear, he would try to add a little to the information they conveyed. Looking first at the

capital account, it would be seen that £22,926 had been spent, of which £14,350 was due to mains, meters, and stoves. Against this, there was a credit for depreciation of £8960, which was all (except £533 for a small piece of land sold) brought from revenue account, where it was included in the items for repairs respectively of works, mains, meters, and stoves. The amount of capital relative to business done had been steadily reduced during a considerable term of years, and was now lower than ever before. This continued progress had been frequently commented upon by him in the past. It now stood at £386 per million cubic feet sold; and the total charge for dividend and interest was only 5·4d. This most gratifying progress would receive a check in the near future. The plant was nearly fully occupied. The increased quantity of gas sold last year was 190 million cubic feet; and there was every reason to believe that growth on a considerable scale would continue for a long and indefinite period. It was necessary therefore to make a large addition to the works; and the estimates which the Directors had before them for this purpose totalled something like £250,000. He remembered that years ago he said that, although he had then been connected with the Company for quite a long time, yet he found it extremely difficult to realize the dimensions of the extensions that would be necessary. The growth of the concern had been abnormal; and although repeated year after year, when it came to the question of deciding what should be the scope of the extensions to be made, one always felt somewhat uncertain as to what the prospects actually called for. A large part of this expenditure would come into immediate profitable use; but as provision was being made for the needs of some ten or twelve years to come, a proportion must for a time be unproductive. For this reason, he said the reduction of capital in relation to gas sold would receive a temporary check. The shareholders need feel no anxiety in regard to this large increase of capital, which would be called up and spent with the same care that had marked the policy of the Board in years gone by. As a first step, the Directors proposed, within a few weeks, to make an issue of "B" stock, of which the proprietors would have due notice.

INTEREST AND DIVIDEND AND METER, STOVE, AND FITTINGS RENTAL.

It was pointed out in August last that the revenue from capital invested in meters, stoves, and fittings in consumers' houses would soon more than suffice to pay the whole of the capital charges. This was now the case. For the last half year, dividend and interest amounted to £20,888; while the revenue from meters, &c., was £21,999.

THE REVENUE ACCOUNT EXAMINED.

With regard to revenue expenditure, the first three items of coal, coke, and oil showed an increase of £9200. Out of this, if there had been no extra price to pay for coal or coke, the increased quantity required for gas making would have equalled £5700, after allowing for the reduced quantity of oil used; so that the extra due to enhanced price amounted to about £3500. The coal requirements to June next were purchased at a favourable time, so the advance in cost was less than it would otherwise have been. Having regard to the greater quantity of gas made, money spent on repairs to works was about the same as in the corresponding half year. Distribution repairs had been a little higher, chiefly due to the greater attention paid, at the Company's cost, to consumers' burners and fittings. Rates were higher by £1900. There had been a new assessment, under which it was proposed to add £15,000 to the rateable value. The Directors were able to effect a settlement which involved an addition of £9000, with an undertaking on the part of the Committee that the arrangement now made should stand for five years without addition for ordinary development of the Company's business. A charge appeared in the accounts for the first time for National Insurance, which represented for the half year £311 against the Company as employers. But he thought, when all the benefits which the Act was calculated to confer upon the community were realized, they would not be disposed to regret the compulsory expenditure of this sum. On the other side of the account, the income for gas was up by £7615, notwithstanding the reduction of 1d. per 1000 cubic feet, which equalled £3885 on the half-year's sale. The income from residuals was more by £8800, partly due to the increased quantity for sale, owing to more coal having been carbonized, and partly due to the increase of prices. The benefit of this increase in the receipts for residuals was shown in the net cost of materials per 1000 cubic feet sold, which worked out for the half year to 5·85d., as against 6·48d. in the corresponding half year, notwithstanding the fact that coal had cost 10·8d. per ton more. He thought the proprietors would agree that, with these figures before them, the Directors were justified in making a further reduction in the price of gas, which took effect from Jan. 1; bringing the price down to 2s. 1d. per 1000 cubic feet, and carrying with it an increase in the dividend, which would bring it up for the current year to 5¾ per cent., and added proportionately to the bonus of the co-partners.

AN INTERESTING CENSUS.

The improvement in the condition of trade in the Company's district, which was noted last year, continued and increased. There was very little unemployment now in the area; and this healthier state of affairs was illustrated by a considerable decrease in idle gas installations. As compared with December, 1911, there had been a decrease of 36 per cent. in the number of meters in empty houses. A systematic examination of the houses in the district, to which he referred last year, had been carried further; and 56,000 houses had now been examined. The result was that they found 26 8 per cent. contained ordinary meters, 66 per cent. had coin meters, and the balance was made up of 5 per cent. where services had been laid but no meters were fixed, and 2 per cent. with no services. The latter were chiefly very small tenements, where the consumers were burning oil. In the 56,000 houses, there were 478 users of electricity. It was worth recording that the Inspector making out this register secured during his round 267 orders to lay services, 150 orders to put on the gas where services were already laid, and 659 orders for stoves and fires. This man deserved well of the Company.

ENLARGEMENT OF THE NUMBER OF CONNECTIONS.

The consumption through prepayment meters had increased in a very satisfactory manner, being now 16,458 cubic feet per meter, or 8·3 per cent. more than 1911. The work done by the Company in advertising and pushing the use of cookers, &c., was shown by the following figures: In 1902 they had in use 4170 stoves and fires, or 18½ per cent. of the number of consumers; and in 1907, they had 9376, or 20·5 per cent. In 1912, they had 31,890, or 50¾ per cent. He need hardly say that there was still room for improvement under this head, as there was no reason why the Company should not have a stove or fire in the house of every consumer. The work due to the migratory character of the inhabitants of the district was shown by the fact that in 1902 15·79 per cent. of the consumers moved; in 1907, 26·3 per cent.; and in 1912, out of 63,000 consumers, 17,750 removed, or 28·2 per cent. of the whole. The Inspection Department had thus during 1912 had to deal with an average of 57 removals for every working day. It might interest the proprietors to know that during the year £87,000, or 20,426,000 pennies, weighing 183 tons, were passed through the counting-machines. He thought these figures (for which he was indebted to the Secretary's enthusiasm for statistics) gave a realistic picture of the work that went on from day to day in the conduct of the business, and illustrated also how much intelligence, as well as of active work, was needed in order to ensure the success for which they were thankful that day. The Chairman concluded by moving the adoption of the report and accounts.

Mr. HENRY BAILEY seconded the motion.

The CHAIRMAN, replying to questions, said with regard to the loan of £20,000 from the bankers, the Directors were of opinion that it was good finance not to raise capital (which was a permanent burden from the very time that it was issued) to meet what, in some cases, were only casual calls—such, for instance, as dividend. The Board had only recently raised the overdraft of £20,000; but they frequently had £10,000 to £15,000 from their bankers. They were able to pay this off as the collections came in, so that they were working at a minimum charge for capital. He had already said the Directors were about to issue £60,000 additional "B" stock; and one of the charges upon this would be to clear off the balance from the bank. With regard to a further question as to the insurance fund, the strict reading of the Company's Act of Parliament would probably call for its investment. But when the Board found that the best securities were subjected at the present time to so much depreciation, they preferred to keep the money in their own business, where it earned a far better return than they could get from outside. Therefore he thought that, so long as matters were going as they were doing, they need not be much concerned about having the money in hand rather than in investments outside bringing in a poor return.

The motion was unanimously carried.

The DEPUTY-CHAIRMAN (Sir Daniel F. Goddard, M.P.) moved the declaration of dividends at the rate of 7¼ per cent. per annum on the "A" consolidated stock and 5¾ per cent. per annum on the "B" stock, both less income-tax. The Directors, he remarked, were paying the same dividend as last year; but in view of the reduction of the price of gas from Jan. 1 last, he thought they might fairly look forward to a slightly increased dividend at the next annual meeting. The Chairman had given the proprietors some interesting statistics as to the growth of the Company; and he had also referred to the general growth of the gas industry. This growth was one of the several striking features of the industry. It was brought very much to their minds when they remembered that last year the Gaslight and Coke Company reached its centenary, having obtained its first Act of Parliament in 1812. He was sure all the proprietors would rejoice with him that the reaching of such an eventful time was accompanied by honour to the Governor of that Company, who was Chairman of their own. [Applause.] The proprietors heartily congratulated Sir Corbet Woodall upon the honour His Majesty had conferred on him. The honour, too, coincided with Sir Corbet's presidency of the Institution of Gas Engineers in its Jubilee year—this being the second time he had occupied that place of honour. Sir Daniel proceeded to refer to the scientific progress that the gas industry had made in the utilization of gas, and to the wonderful cheapening that had been effected in the cost of illumination by low and high pressure gas-burners.

Mr. JAMES CLOUDSLEY seconded the motion, which was unanimously adopted.

Mr. H. D. ELLIS moved a hearty vote of thanks to the Chairman and Directors, Auditors, officers, staff, and workmen. He assured the Chairman and Directors of the high appreciation and gratitude of the proprietors for the results they had placed before them, and the officers, staff, and workmen of their appreciation of their loyalty.

Mr. MITCHELL, in seconding, asked [Mr. Ellis agreed] that the resolution might be extended by incorporating in it an expression of the sincere pleasure the proprietors felt regarding the honour conferred upon the Chairman by His Majesty. It was an appreciation of the work of one of the captains of industry, who had done much to cheapen the price of gas; and who had been also largely instrumental in materially reducing Sunday labour in gas-works.

The resolution, as extended, was received with great cordiality; the co-partner employees especially marking their appreciation.

The CHAIRMAN, in reply, said the resolution was one of a kind with which he always found it extremely difficult to deal; the proprietors of this Company being on all occasions so exceedingly cordial in their appreciation of the work of the Directors. The speeches to which they had listened came appropriately when they were taking so much interest in co-operative work; and he was glad to have the staff and workmen included in the vote to the Directors. Perhaps he (Sir Corbet) might be allowed to say a word with regard to a remark made by the last speaker. It had thrown his memory back a great many years, when the late Sir George Livesey and the late Mr. Robert Morton and himself, with the Secretary of the Lord's Day Observance Society, used to meet every Saturday for many months discussing and considering the best way of reducing Sunday labour in gas-works. He was sure the honourable proprietor had not in the least exaggerated the importance of the result of these consultations. He (the Chairman) was certain the day of rest had an influence upon the character of the men who served

them so well. It had improved their social condition very materially. A natural consequence of this movement was a substantial addition to the pay of the workmen when they were engaged on a Sunday; and that was a step in the right direction, although sometimes it was rather an inducement to the men to desire, when the treasury was low at home, to have Sunday work, because of the higher pay. But he was sure that what had been done in the abolition of Sunday work had done much to contribute to the maintenance of that grand principle of a Day of Rest. Then the co-partnership in which they rejoiced, and with which they felt quite satisfied, had a beneficial effect all round, and was a natural evolution from the measures to which he had referred. Personally, and on behalf of his colleagues, he thanked the proprietors.

Mr. A. E. BROADBERRY (the Engineer and Manager), called upon by the Chairman, remarked that he could say truthfully it gave the whole of the staff, right down to the office boy, a great deal of gratification that they were able to bring such a successful balance-sheet before the proprietors that day, under the guidance of their able Chairman and Directors. In thanking the proprietors for his colleagues and himself and men, he said they all hoped to fight the good fight in the same way in the future as they had tried to do in the past.

Enfield Amalgamation and Electricity Supply Bill.

An Extraordinary Meeting was then held to consider, and, if thought fit, to approve of, the Bill promoted in Parliament, intituled—"A Bill to Provide for the Transfer of the Undertaking of the Enfield Gas Company to the Tottenham and Edmonton Gaslight and Coke Company, and to Confer on such Company certain Powers in regard to the Supply of Electricity, and for Other Purposes."

The SECRETARY having read the notice convening the meeting,

The CHAIRMAN said the proprietors had before them matters of great importance. The Bill (which would be explained by their Parliamentary Agent, Mr. Lees) had two objects in view: First of all, the amalgamation of the undertaking of the Enfield Gas Company, and, secondly, the transfer from the Wood Green Urban District Council of the Order granted to them by the Board of Trade authorizing the supply of electricity. The district of the Enfield Company was about as large as that of the Tottenham Company, and over a considerable portion of it development and increase of population was taking place. The price charged for gas was 3s. 1d. per 1000 cubic feet; and they would be able to at once reduce that to the benefit of the consumers in the Enfield district, while at the same time making a sufficient profit to secure the consumers in Tottenham from any risk of loss. The total consumption of gas last year was 250 million cubic feet, which the proprietors would notice was not much more than the increase in the Tottenham area for one year. At the same time, it would bring a considerable additional strain on their present undertaking if they transferred the manufacture from Enfield to Tottenham. Such was not, however, their present intention. The works at Enfield were capable of providing for sudden increase; and, at any rate during the period of maximum demand in the winter, it would probably be to the Company's interest to keep the works employed. The increase in the capacity of the Tottenham works, to which he had already referred as having been authorized, was due to the demands in Tottenham. With regard to the proposed electricity supply in Wood Green, he might explain that it was not only recently that they had entertained the idea of adding electricity to their gas business. In 1896 he interviewed most of the local authorities in the district, and took the advice of Sir Alexander Kennedy as to the prudence of the course proposed. He (Sir Alexander), though not greatly impressed with the prospects then afforded by the district, thought an established Company such as theirs could provide current at a reasonable price for the limited demands likely to be found. In the Company's 1898 Act, they took power to apply for a Provisional Order for electric lighting, and to devote funds to putting it into effect. In 1902, the District Councils in the area obtained Orders, which none of them had put into operation; Southgate, Edmonton, and Tottenham having all arranged to hand theirs over to the North Metropolitan Electric Power Supply Company. Three years ago, Wood Green offered the Metropolitan Power Company the same thing; but they (the Electric Power Company) refused. In 1904, the Tottenham Council invited the Gas Company to quote for their Order in competition with the North Metropolitan Electric Power Supply Company; and this the Gas Company declined to do, although quite willing to submit an offer which would be open to acceptance or rejection. In Wood Green, the Gas Company already supply three rather important electric installations with gas for power purposes—viz., the Alexandra Palace, the Market Hall, and a very large group of stores. The Directors therefore decided that the time had come when they might offer to take over the Wood Green Council's Order, and complete the work which they had already carried out to a considerable extent. It was very much to be regretted that the North Metropolitan Electric Power Supply Company, through their subsidiary Company, were seeking an Order direct from the Board of Trade to over-ride the Council's Order, the transfer of which they refused to consider three years ago, and which the Board of Trade had again extended specifically in order that the Council might arrange for its transfer to some responsible Company, which the Gas Company claimed to be. They were paying the Wood Green Council a price for the Order; and were undertaking to supply at 5d. per unit within one year, and to transfer after fourteen years on favourable terms. The Electric Company, on the other hand, asked for 8d. per unit, a minimum of 20 units per quarter, two years for the work, allowing no purchase price or compensation to the Wood Green Council, and no special terms for transfer to the Council. The Bill would be supported by the Enfield and Wood Green Councils. It would not be opposed by Edmonton or Southgate; and as Tottenham were arranging to have a conference, the Board hoped that there would be no opposition from this quarter either. The Middlesex County Council had also notified that they did not intend to oppose, although they also asked for a conference; and except for the opposition of the North Metropolitan Power Company, which could only be sustained if they obtain their Order, the Bill looked like being unopposed. He could claim that the Directors had done their utmost to satisfy the local authorities within their area of supply and to serve the districts well; and it was gratifying to find, as a result, the very friendly consideration which was now being extended to their proposed extension of powers.

Mr. LEES (Parliamentary Agent) having explained the clauses of the Bill,

The CHAIRMAN moved a resolution approving of the Bill, and authorizing the Directors to proceed with it, subject to such amendments as Parliament might require, and with which the Directors could agree.

Sir DANIEL GODDARD seconded the motion.

The CHAIRMAN, referring to an inquiry as to why the Tottenham Council were opposing the Bill, said he could explain pretty thoroughly the purposes of the Company in promoting the Bill; but it was beyond him to explain why the Tottenham Council, or any other Council, should seek to oppose it. [Laughter.] He, however, thought that the Tottenham Council had done well in deciding to lodge a petition, so that they might be in a position to watch the Bill, and to obtain amendment if they saw fit, and if they could convince the Directors or Parliament that such amendment was necessary. He did not think, however, from what he gathered as to the relations the Company held with the Tottenham Council, that the opposition would be of an unkind nature.

The resolution was unanimously adopted.

The CHAIRMAN: I am glad that a Bill of this importance has been passed by the proprietors without a single dissentient.

BRENTFORD GAS COMPANY.

Half-Yearly Report and Accounts—Reduction in Price.

The Directors of the Brentford Gas Company, in their report for the six months ended the 31st of December, which will be presented at the half-yearly meeting on the 21st inst., state that the accounts show a profit of £61,778. After providing for fixed charges, there remains a sum of £57,896, which, with the balance brought forward, makes £150,453 available for distribution. They therefore recommend the declaration of dividends at the rates of 5, 14, and 11 per cent. per annum, subject to income-tax, on the preference, consolidated, and new stocks. The Directors report an increase of 10·24 per cent. in the output of gas in the half year; but they state that the price which will have to be paid for coal under the new contracts shows a serious increase. They nevertheless feel justified in announcing a further reduction in price of 1d. per 1000 cubic feet, to take effect after the completion of the reading of the meter indices for the Lady-Day quarter.

The accounts accompanying the report show that the revenue from the sale of gas amounted to £195,810; from the rental of meters, stoves, and fittings, to £28,385; and from the sale of residual products, to £54,643—the total receipts being £278,881, as compared with £252,155 in the second half of 1911. The expenditure on the manufacture of gas was £144,758; on distribution, £42,717; and on management, £9134—the total expenses being £217,103, as compared with £205,146 in the six months ended Dec 31, 1911. The balance carried to the profit and loss account is £61,778, compared with £47,009 this time last year; and the amount available for distribution is £150,453, against £124,934.

The working statements show that, under the supervision of Mr. Alexander A. Johnston, the Engineer and Manager, 95,161 tons of coal and 1,605,420 gallons of oil were used in the past half year in the production of 1,772,766,000 cubic feet of gas (including 626,687,000 cubic feet of carburetted water gas), of which 1,613,384,000 cubic feet were sold and 1,639,137,000 cubic feet were accounted for. The estimated production of residuals was: Coke, 59,516 tons; breeze, 8482 tons; tar, 1,245,159 gallons; ammoniacal liquor, 30,143 butts.

SOUTH SUBURBAN GAS COMPANY.

Half-Yearly Report and Accounts—The Enlarged Undertaking.

The following is the report of the Directors of this Company for the half year ended the 31st of December, which will be presented at the ordinary general meeting on Friday.

The South Suburban Gas Act, 1912, authorizing the inclusion with this Company of the Bromley and Crays and the West Kent gas undertakings, received the Royal Assent on the 7th of August last, and came into operation on that date. The accounts now presented are those of the enlarged undertaking created by that Act.

Including the balances brought forward from last half year, and after providing for debenture and mortgage interest and other payments, the amount available for dividends is £46,408 3s. 7d., out of which sum the Directors recommend payment of the full statutory dividends as follows: On the 5 per cent. preference stock, 5 per cent. per annum; on the 5 per cent. ordinary stock, 6 per cent. per annum; on the 5 per cent. (West Kent) ordinary stock, 5¼ per cent. per annum—carrying forward to next half year £12,836 16s. 7d.

The increased dividend of 3s. 4d. per cent. on the two classes of ordinary stock, as represented by these figures, follows the reduction of 1d. per 1000 cubic feet which was made as from the 1st of July last in the then South Suburban area; simultaneous reductions of 2d., 5d., and 3d. per 1000 cubic feet having been made in the Bromley, Crays, and West Kent areas respectively, as provided by the above-named Act. The aggregate annual value of these reductions to the consumers is approximately £12,000.

The loss of revenue corresponding to these reductions has as yet been only partly made up by an increased consumption of 3·29 per cent.; while the great rise in the price of coal has added most seriously to the cost of manufacture, though counterbalanced to a moderate extent by improved receipts from residuals, notably coke and tar.

Connecting-mains have been laid between the works at Lower

Sydenham and Bromley, and between Crays and Crayford. These complete the linking-up of the five distributing centres in the combined area; there having been already connecting-mains between the Erith works and Crayford, and between the Bromley works and Crays. The through connection now established enables gas to be supplied to any part of the combined area from the cheapest manufacturing station.

An Approved Society has been formed under the National Health Insurance Act, and numbers 805 members; being practically all the eligible employees at all the works. In its formation the Directors were greatly assisted by the Co-Partnership Committee, in whose hands its management has been placed by a unanimous vote of the members in general meeting. This scheme of management is alternative to the one provided for in the Act, and has been sanctioned by the Insurance Commissioners on the initiative of the South Metropolitan Gas Company.

Two Directors (Mr. Charles Hunt and Dr. Charles Carpenter) retire from office at this meeting, and, being eligible, offer themselves for re-election. One Auditor (Mr. Thomas Guyatt) also retires from office at this meeting, and has intimated his intention of not offering himself for re-election. Mr. Ernest W. Drew, F.C.A., a duly qualified stockholder, has given notice of his intention to offer himself for election in place of Mr. Guyatt.

At the last half-yearly meeting, notice was given by a stockholder of his intention to move at this meeting that the remuneration of the Directors be increased.

Mr. W. G. Waller, the retiring Employee Director, has been re-elected by the employees without opposition.

The accounts accompanying the report show that the total capital expenditure at the close of the half year (including a nominal amount of £412,103 added by conversion) was £1,407,839, or £24,442 less than the receipts, inclusive of the premium capital. The total receipts (£1,432,281) include the capital issued in respect of the acquisition of the Bromley and West Kent undertakings—£419,295 and £135,000 respectively. A sum of £29,067 was expended on capital account in the half year. The revenue from the sale of gas was £122,251; the rental of meters and stoves produced £11,279; the rental of fittings, £4289; the sale of residuals, £54,496; and the total receipts were £192,477. The following were the principal items of expenditure: Gas manufacture, £99,224; distribution, £31,552; management, £9224; rents, rates, and taxes (£6179) and miscellaneous items bringing up the total to £153,673. Among these items is £2750 charged on account of the co-partnership scheme. The balance carried to the net revenue account is £38,804; and the amount applicable for dividend is stated as £46,408.

The statements as to working show that, under the supervision of Mr. S. Y. Shoubridge, the Engineer, 83,306 tons of coal were carbonized in the half year. The quantity of gas made was 1,090,925,000 cubic feet (1,009,652,000 cubic feet of coal gas and 81,273,000 cubic feet of oil gas), of which 994,628,100 cubic feet were sold and 1,006,686,100 cubic feet accounted for. The residuals were: Coke, 999,672 cwt.; breeze, 22,187 yards; and tar, 824,010 gallons—the make of sulphate of ammonia being 884 tons.

NEWPORT (MON.) GAS COMPANY.

Reduction in Price.

The Ordinary Half-Yearly General Meeting of this Company was held on Monday last week—Mr. T. G. Cartwright (the Deputy-Chairman) presiding, in the absence, through indisposition, of Dr. H. Melvill Brewer, the Chairman.

The Secretary (Mr. T. H. Hazell) having read the notice convening the meeting, the report of the Directors, with the accounts for the six months ended Dec. 31, was presented. These showed a balance of £11,016 available for distribution; and the Directors recommended the payment of the statutory dividend.

The Chairman, in moving the adoption of the report, referred to the unavoidable absence of Dr. Brewer, who, he assured the shareholders, took the greatest interest in everything that went on at the works. He also alluded to the loss the Directors had sustained by the death of Mr. C. D. Phillips, who had been a valued member of the directorate for many years. To fill the vacancy, they had elected Mr. Thomas Canning, who had been with the Company nearly forty years, to a seat at the Board, though he would still retain the position of Engineer. His son, Mr. J. H. Canning, would succeed him as Manager at Crindau. With regard to the progress of the Company, there had been an increase of 4·8 per cent. in the sale of gas in the past six months as compared with the second half of 1911; but they had to meet an increased cost of coal to the extent of 1s. per ton, which would mean £1900 a year to the Company. The sale of residuals had been very satisfactory, owing, he thought, to the use by local authorities of a new preparation on the roads. As the result of the half-year's working, the shareholders would receive their usual dividends, and the Board be able to carry forward a small increased amount to the next half year. In anticipation of the results of the extensions at Crindau, the Directors had pleasure in announcing a further reduction of 1d. per 1000 cubic feet in the price of gas for lighting, heating, and cooking purposes—the change to take effect upon the reading of the meters for the March quarter. They had now up-to-date and excellent works at Crindau, and their business was increasing in all departments. The high-pressure lamps used in the town had given great satisfaction. The demand for cooking by gas-fires was largely on the increase, and all they required as a Company was cold weather.

Mr. G. Geen seconded the motion.

Mr. T. H. Mordey congratulated the Board upon the excellent appointments they had made. Their friend Mr. Thomas Canning had served the Company faithfully for many years; and he (the speaker) hoped he might long be spared to occupy the position he had been chosen to fill.

Alderman Howell, in supporting the motion, congratulated Mr. Canning upon his appointment. He said the Board could not have done better than select him as a Director.

The motion having been carried unanimously,

Mr. Canning, in reply, thanked the speakers for their kind personal references to himself.

A dividend of 5 per cent. on the consolidated stock for the half year was then declared; the Directors' remuneration was increased to £1000 per annum, as from the 1st ult.; and thanks were accorded to the Chairman, the Directors, and the staff for their services, the Chairman remarking that the Company had a loyal and hard-working staff from top to bottom.

SWANSEA GAS COMPANY.

A Prosperous Concern Requires More Capital—The Co-Partnership Scheme.

The Annual General Meeting of the Swansea Gas Company was held on Friday last—Mr. R. G. Cawker presiding, in the absence of the Chairman (Mr. J. Glasbrook) and Deputy-Chairman (Dr. T. D. Griffiths).

The Chairman, having expressed regret at the absence of Mr. Glasbrook through illness, pointed out that the Company's progress for the year had been satisfactory, an increased quantity of gas having been sold. The expenditure had, however, been greater, owing to the dearness of coal and the results of the railway and coal strikes, which were felt even to that date, and had caused an advance in the cost of all raw material.

The retiring Directors and Auditor having been re-elected, hearty thanks were accorded to the Chairman, the Directors, and the Engineer and Manager (Mr. G. Thornton Andrews), for their attention to the Company's business during the past twelve months.

Subsequently a special meeting was held to authorize the raising of additional capital.

The Chairman, in the course of his remarks, mentioned some interesting facts bearing upon the Company's progress—viz., that the make and sale of gas had more than doubled themselves for the last twelve years or so, and that the extensions of mains, especially in the outlying districts, had also been considerable. He explained that the additional capital was required for the works at Morriston, where the Directors were about to commence operations, and for other matters, such as the extension of works and the improving of the plant and machinery.

Resolutions were passed authorizing the Directors to raise a sum of £110,000, partly in ordinary stock and partly in debentures.

The Chairman then explained the co-partnership scheme which the Directors had under consideration, and dealt in detail with the objects of co-partnership and profit-sharing.

After some questions had been asked, it was unanimously resolved that the Directors should proceed with the formation and putting into force of a scheme on somewhat the same lines as those indicated.

MALVERN GAS UNDERTAKING.

Projected Main Extensions—Report by Sir Corbet Woodall.

Faced with the necessity of meeting the requirements of the district, the Malvern Urban District Council have for some time had under consideration the advisability of expending a large amount on the extension of their gas-works. They have had before them a report by their Gas Engineer and Manager (Mr. W. J. Rendell Baker); but they decided to obtain the opinion of Sir Corbet Woodall, whose report was discussed at the meeting of the Council last Tuesday. In the course of it, he said that if the Council were in need of further gasholder room, he would agree with the suggestion made by the Manager that a new holder should be built at Malvern Link; but as the storage was already very ample in proportion to the output—being something like 130 per cent. of the maximum day's make, while 90 per cent. was sufficient for economical working—it would be extravagant to adopt this plan. The alternative was to improve the methods of distribution. The plan he recommended was also dealt with by the Manager. It was to carry a main from the storage station to a spot where it would take up the mains for the eastern point of the area, and afford a much improved pressure. He had been told that numerous complaints had been made of bad gas. From his investigation, he was disposed to say emphatically that there had been no justification for such complaints; they having arisen entirely because of a deficiency in the supply. He thought the Council should be prepared to spend at once on the new main and the renewal of old ones at least £3000; and he did not hesitate to say that such expenditure would be immediately productive of a good return. The arrangement of the works was good, the plant of excellent design, and sufficient in capacity. The whole undertaking seemed to be run with intelligence, and the staff evidently took pride in the works. There should be no occasion for spending money upon extensions for a considerable time, and the profits of the undertaking should be on an increasing scale. Main laying, however, had not kept pace with the needs of the district, and the gas undertaking had consequently obtained a bad name, which he had no doubt had been greatly detrimental to its progress. The financial success of the undertaking had been considerable, and would increase as the capital relative to business done was reduced. The reduction in this item was noteworthy. In 1901 the capital employed per million cubic feet of gas sold was £746; in 1911, the corresponding figure was £513. It was resolved to refer the report back to the Gas Committee, without any expression of approval or otherwise of its contents.

PUBLIC LIGHTING OF FELIXSTOWE.

Contract with the Gas Company Sealed.

At the Meeting of the Felixstowe and Walton Urban District Council last Wednesday, the Lighting Committee reported that they had settled the formal contract with the Felixstowe Gas Company for public gas lighting in the district up to Dec. 31, 1919. In view of the period that must elapse to enable them to negotiate the proposed street electric lighting within the radius of 150 yards from the back of the Promenade, they had thought it desirable to obtain terms from the Gas Company for continuing for a time the existing street gas lighting within the radius; and they were prepared to so continue under the terms of the contract between them and the Council, which expired on Dec. 31 last. The Committee recommended that the seal of the Council should be affixed to the contract for public lighting by gas in the district outside the 150-yard radius from the back of the Promenade up to Dec. 31, 1919, and also to the contract for continuing the existing lighting within this radius from time to time for periods of not less than three calendar months, at the rate or rates specified in the contract between the Company and the Council, dated Jan. 22, 1910, until the Council are ready to light by electricity the streets within the radius. Questions were raised as to the advisability of the Council entering into a contract for seven years; one member characterizing it as madness. The Chairman (Mr. C. F. Fish) said both the Lighting Committee and the Council had gone carefully into the matter; and they were perfectly satisfied that it was the correct thing to do. Under the contract, the Council obtained considerably better terms than if an agreement for three years had been made, as before. The recommendation of the Committee was approved.

WORKINGTON CORPORATION GAS UNDERTAKING.

Proposed Extensions at the Works.

At the Meeting of the Workington Town Council last Tuesday, Mr. Hall, the Chairman of the Gas Committee, moved the approval of a recommendation by them that a sum of £7000 should be spent upon extensions at the gas-works. He explained that in 1894 the plant was arranged for an output of 50 million cubic feet of gas per annum; and for that year the Committee actually sold 49 millions. But last year the quantity sold and accounted for was 103 millions—an increase of 54 millions, or 112½ per cent.; and though in the present financial year they incurred a loss at the beginning owing to the coal strike, this had been cleared off, and at the end of January they had actually an increase of 1½ million cubic feet by comparison with the previous year. From the report of the Engineer (Mr. E. G. Hutchinson) they would gather that it was almost impossible to deal with the purification of the gas made with the limited plant at their disposal. It was proposed to put down new plant to be ready for next winter, if they were to keep faith with their customers and cope with the increasing demands on the Gas Department. With reference to the holders, their storage capacity was now 580,000 cubic feet, as it was in 1897, when the No. 2 holder was erected. In that year the largest day consumption was 317,000 cubic feet; whereas in the present financial year it was 549,000 cubic feet—an increase of 73·1 per cent. If this rise continued, unless something was done they would not have a full day's supply in hand. This lack of storage hampered their working very considerably; and by adding a third lift to No. 2 holder it would give them a further storage of 170,000 cubic feet, or 750,000 cubic feet in all. This was what the Committee recommended, as the erection of an entirely new holder would cost from £6000 to £7000. In regard to the carbonizing plant, their system of hand-fired horizontal retorts had reached their limit. From information gathered from time to time, they had been assured that by adopting some other system they could increase their profits by £1500 to £2000 per annum. If new plant were to be put down, it would be at least three or four years before any repairs would be necessary; and as they spent, on an average, about £500 a year on repairs, this would mean a saving of £2000 towards the cost of the new plant. After some remarks, the recommendation was adopted.

Additional Carbonizing Plant for Birmingham.

The proposals of the Birmingham Gas Committee to enter into contracts for an installation of Dessau vertical retorts of a capacity of 3 million cubic feet per diem, and for an extension by 54 ovens of the experimental installation of Koppers ovens already erected (as stated on p. 315 of last week's issue), were considered at Tuesday's meeting of the City Council. An amendment was moved to the effect that the portion of the proposals which related to the Koppers ovens should be deferred for twelve months, and that in the meantime the Committee should obtain further information as to the success of the present installation. This, however, was defeated; and the Committee's propositions were agreed to.

Fatality at the Neepsend Gas-Works.—Mr. J. Kenyon Parker, the Coroner for Sheffield, held an inquiry last Thursday into the circumstances attending the death of William James Hare, a coke wheeler, which took place at the Royal Infirmary on the previous morning as the result of injuries sustained by him at the Neepsend station of the Sheffield Gas Company on the 1st inst. The foreman stoker deposed that while quenching coke in one of the retort-houses deceased was crushed between the frame of a charging-machine and a pillar—there being a space of only 3 inches. Deceased should have been working on the other side of the pillar. The driver of the machine, in answer to the Coroner, said he remarked to deceased on the day before the accident that he had no business to walk on the side of the pillars on which the machine was working; and Hare replied that he could look after himself if witness would look after his machine. The Jury returned a verdict of "Accidental death."

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The notes upon the addition of a few feet to the height of a gasholder tank which Mr. G. P. Mitchell gave to the Eastern Juniors at Dundee to-day were interesting, not only as a description of work done which may often have to be undertaken by the junior, but also as a note of a new method of accomplishing the desired object. The ready means which ferro-concrete allows of joining the new portion to the old is alone a recommendation for its use; but there are other reasons which further commend it—namely, that the new portion is light, and also that the piers will add to the strength of the walls below the ground. It was unfortunate that Mr. Ferguson was not well enough to read his communication, and that, by a sequence of infortuitous circumstances, there was no copy of the paper available for reading. It was suggested that the paper should be taken as read, published in the Technical Press, and discussed at the next meeting of the Association.*

Mr. Yuill, in the course of a lantern lecture on the Dundee Gas-Works, related an experience of working with a single producer for nine through retorts requiring double the coke of each of the two smaller producers formerly in use in the same arch. This shows that the heat from the coke was fully utilized in each case, and is what one would have expected. The radiation and convection from the setting would not vary; and if the combustion is complete and the products leave the setting at the same temperature, then the same quantity of heat will be required and the same amount of fuel used as in the two furnaces. Another remark of Mr. Yuill's on the saving, by the use of an inner arch to the setting, of 1 cwt. of coke per ton of coal carbonized is very interesting. All know that a confined air space is a bad conductor of heat; but one would not have given it credit for making such a large saving of fuel. The arrangement should be made known generally, so that others may benefit by it. It consists of building above the top retorts an arch or layer of tiles under the main arch of the setting and a few inches below it, so that the space between acts as an air chamber and prevents the passage of the heat to the arch and top of the beds, and so retains some of the 8 per cent. loss by radiation and convection.

The Gas Convener—Mr. Noble—in welcoming the Association to Dundee, at the tea provided by the Gas Commission, referred to the fact that he had been originally intended for the gas profession, and arrangements had at one time been made for him to enter the offices of the Gaslight and Coke Company in London. These afterwards fell through; but as a shareholder in the Company he had always taken an interest in gas matters. More recently he had been appointed to the Convenership of the Gas Committee of Dundee, and he would have to take an even greater interest. He referred to the good that visits to gas-works did to members of such an Association, and wished the public would also visit them. Why should not the gas companies and corporations arrange for periodical visits of the local consumers to their gas-works? The gas-works, where they were under municipal control, were the property of the people; and probably many of the complaints now made would vanish when the care taken in the manufacture was understood. This was a matter which was worthy of some thought; for while societies of various kinds did occasionally visit gas-works, the general public did not necessarily belong to these bodies, and were therefore ignorant of the method of making the commodity they were daily using.

The paper read before the Western Juniors by Mr. T. Carmichael, of the Dawsholm Gas-Works, on "Gas for Light, Heat, and Power," was a most comprehensive one. Starting with Murdoch's first experiments at Redruth, touching upon the various types of retorts, and very specially upon the Glasgow verticals, which were described somewhat fully, the author passed on to the quality of gas supplied now as compared with that sent out some years back. He put lighting by the old flat-flame luminous burner at 15 per cent.; but it was very doubtful at the present time whether there was so much as this proportion used for the purpose. The description of the different types of flames was clear; and if there was nothing new in the matter, there was at least good information for many of the juniors which cannot be too often repeated. The necessity of supervision and periodical cleaning of burners was certainly a good thing for gas companies, as one satisfied consumer was worth fifty grumblers. The comparison of gas and electric light costs cannot be too often brought forward; and the advantages of efficient ventilation and the assistance which it got from the gas-burner was clearly shown by Mr. Carmichael. Heating was referred to, and comparative costs of gas and electricity were given. In comparing the costs of coal gas and suction gas, he showed that the latter, with anthracite at 25s. per ton, was dearer than coal gas at 1s. 6d. per 1000 cubic feet, and about half the price of an electric motor.

Glasgow.—The question of the chemical works in connection with the Gas Department was raised at the meeting of the Glasgow Town Council on Thursday, when, in reply to a question by Councillor Anderson, Bailie Paxton said he did not see why they could not carry out the manufacture of bye-products in the same satisfactory way that they had done in the making of gas. The works for the Dalmarnock bye-products were at present standing empty; and it was proposed that, as the Tradeston contract was running out next Whitsunday, the Corporation should make an experiment there. He would not be contented with Bridgeton, but would have the whole work in their own hands. Mr. Anderson suggested that the Committee desired to demonstrate what had been demonstrated over and over again—that, when competing with private people, the Corporation always failed. Mr. Renfrew, in seconding the proposal, said they would make a profit of £200,000 a year. The minute was carried by a large majority.

Aberdeen.—The increase in the output of gas has been phenomenal, amounting as it does to about 15 per cent. during the past six months.

* The two papers referred to, as well as the one read at the meeting of the Western District on Saturday by Mr. Carmichael, will be found in other parts of the "JOURNAL."—ED. J.G.L.

This is due principally to the policy of supplying free cookers, and also to the greatly extended use of the gas-fire. There is no doubt that if the public could be made more thoroughly aware of the great improvement shown by the modern gas-stove over the older types, they would be very largely adopted. So many people who tried gas-fires in former days found them expensive, and, while realizing the comfort and labour-saving advantages, were deterred from continuing their use owing to the increased cost over the coal-fire. Since then the gas-fire has been so much improved that probably only 50 per cent. of the gas is required to heat a given sized room as compared with that required ten years ago. At the same time, the price of coal has continued to rise, while the price of gas has been lowered from year to year, until now there is very little difference (if any) in the cost of gas-fires and coal-fires; and the many advantages of the former need not be touched upon here. In consequence of the increase in the consumption, the Town Council have recently placed an order with the Woodall-Duckham Vertical Retort and Oven Construction Company, Limited, for five settings of their continuous vertical retorts. The bench consists of 20 retorts, capable of carbonizing 120 tons of coal per twenty-four hours. The contract is to be completed by the end of September. Further extensions of plant are being contracted for, including coal breaking and conveying machinery, as well as exhausting plant, comprising two exhausters, each capable of passing 120,000 cubic feet of gas per hour. The total expenditure is estimated at about £20,000.

Busby.—The opposition of the Busby and District Gas Company to the Glasgow Gas Consolidation Bill was recalled by an appeal, which was disposed of by the First Division, by Messrs. Robertson and Gordon Shaw, the Law Agents in the matter, for payment of £92 15s. 5d.—£14 7s. 2d. for professional services rendered in endeavouring to negotiate a sale of the defenders' undertaking, and £78 8s. 3d. for professional services rendered, witness fee, and relative outlays in connection with defenders' opposition to the Glasgow Gas Consolidation Bill of 1910. The Lord President stated that, upon the main portions of the accounts, he did not think there was any defence at all; but he did not consider they had actually proved that there was a change of circumstances in regard to the £14—the circumstances being that they would not charge the fee unless the sale of the gas-works was accomplished. He, however, considered that the Auditor should deal with the £14; and he gave expenses against the Gas Company. Lord Johnston and Lord Mackenzie concurred.

Duns.—Considerable interest is being taken in the question of the gas supply, which is in the hands of a private Company. Bailie More complained of the quality, and also of the price—5s. 5d. per 1000 feet. He said that the ordinary jet burners were useless with the quality supplied, and that incandescent burners had to be used, and the mantles only lasted a few days. Has Bailie More tried special burners or caps for the quality given? And has he tried standard mantles? Hints were given at the Town Council meeting that electricity might be introduced; but such a scheme would involve heavy expenditure and raise much opposition.

Johnstone.—The Gas Committee of the Town Council have reduced the leet of candidates for the Burgh gas managership from 12 to 6.

Kirkcaldy.—A meeting of the First Ward Ratepayers' Association was held on Thursday, when the question of the proposed spending of a large sum on new gas-works was objected to; and a special meeting of the Association has been called for next Thursday to protest against the proposed extension.

Peterhead.—Provost Leask and most of the older members of the Town Council objected, at the last meeting of the Council, to the investigation which the Gas Committee had decided upon, and which Mr. Miller was engaged for. After a long discussion, the minute was approved by seven votes to five.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Feb.* 8.

Sulphate of Ammonia.

During the past week the market for this material has remained without much animation, and though there has not been any further material decline in values, there has continued to be a drooping tendency. Supplies have proved ample to meet all demand, both for covering old contracts and for executing the fresh orders which have come along. The closing quotations are £14 3s. 9d. per ton f.o.b. Hull, £14 5s. per ton f.o.b. Liverpool, and £14 6s. 3d. per ton f.o.b. Leith. So far as manufacturers are concerned, business in the forward position is practically neglected; but it is reported that dealers are taking orders for delivery up to June next at a very small premium on prompt values.

Nitrate of Soda.

The tone of this article continues very firm, and the prices are 12s. 1½d. per cwt. for ordinary quality, and 12s. 3d. for refined, on spot.

LONDON, *Feb.* 10.

Tar Products.

There is no material change in the market for tar products, though on the whole prices remain fairly steady. Pitch maintains its price; and a fair amount of business has been transacted at the equivalent of to-day's quotations. Benzols are quiet; and there is not much new business doing. There is very little demand in solvent naphtha for either prompt or forward delivery. Heavy naphtha is fairly steady; and the price remains unaltered. Creosote is firm, with the inquiry good; and further contracts are reported at present prices. Crude carbolic remains in about the same position; but business is difficult to negotiate.

The average values during the week were: Tar, 30s. 6d. to 34s. 6d. Pitch, London, 49s. to 49s. 6d.; east coast, 49s. to 49s. 6d.; west coast, Clyde, 48s. to 48s. 6d.; Manchester, 46s. 6d. to 47s.; Liverpool, 47s. to 48s. Benzol, 90 per cent., naked, London, 10½d. to 11½d.; North, 9½d. to 10d.; 50-90 per cent., naked, London, 10⅜d.; North, 10d. to 10½d. Toluol, naked, London, 10½d. to 11d.; North, 10d. to 10½d. Crude naphtha, in bulk, London, 5⅜d. to 5⅝d.; North, 5d. to 5½d. Solvent naphtha, naked, London, 1s. 1d. to 1s. 1½d.; North, 1s. 1d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. f.o.b.; North, 10½d. to 11d. f.o.b. Creosote, in bulk, London, 3¼d. to 3⅜d.; North, 3⅛d. to 3¼d. Heavy oils, in bulk, 3¼d. to 3⅜d. Carbolic acid, casks included, 60 per cent., prompt, east and west coasts, 1s. 11½d. to 2s. Naphthalene, £5 to £9; salts, 50s. to 55s., bags included. Anthracene, "A" quality, 1⅛d. to 1⅜d. per unit, packages included and delivered.

Sulphate of Ammonia.

The market has been exceedingly quiet during the past week, and business is reported at many ports at lower prices. Beckton is still quoted at a very high figure; but outside London makes are quoted to-day at £13 10s. to £13 11s. 3d. In Leith, the price is £14 8s. 9d., although sales are reported to have been made at under this figure; while Liverpool is £14 6s. 3d.; Hull, £14 5s.; and Middlesbrough, £14 5s.

The Bradford Corporation Gas Committee have renewed the following contracts for delivery of muriate of ammonia during 1913; Lye, 20 tons at £27 7s. 6d. per ton; Brighouse, 4 tons at £27 per ton. Of sulphate of ammonia, 100 tons have been sold (f.o.b. Liverpool) at £14 6s. 3d. per ton, and 50 tons at £14 8s. 9d. (f.o.b. Liverpool).

COAL TRADE REPORTS.

Northern Coal Trade.

There is a good demand for coal; but supplies seem to be adequate, and the prices are just about maintained. In the steam coal trade, for prompt delivery, there is a good inquiry. Best Northumbrian steams are from 15s. to 15s. 3d. per ton f.o.b.; second-class steams are about 14s.; and steam smalls are easier at 10s. 3d. to 10s. 9d., according to quality. For delivery over next month, there are occasional concessions in price. The gas coal trade is generally active, with good supplies. Best Durham gas coals are from 15s. to 15s. 3d. per ton f.o.b.; second-class gas coals are about 14s.; and "Wear" specials about 15s. 9d. The contracts for gas coals reported are only few; but the market has derived a little benefit from some sales of north-country coals for the Swedish Railways, which show advances of some moment on those of the previous contracts. Gas coals are, however, being offered rather more freely forward, though the chief collieries are well sold to the middle of the year. The stormy weather has hindered shipments a little; but there is still some desire to increase the stocks of gas coal, which are not so heavy as they were. Coke is a little easier. Gas coke may now be quoted at about 19s. per ton f.o.b. in the Tyne—there being rather full stocks at some of the inland gas-works.

Scotch Coal Trade.

During the past week, there has been no falling-off either in respect of demand or of values in the Scotch coal trade. Coal masters are now well booked up for all classes of fuel for well into the next month—in most cases at slightly enhanced prices. On Friday, the following were the quotations: Steam coal, 13s. 6d. to 14s. 6d.; splint, 15s. to 15s. 6d.; ell, 13s. 6d. to 14s. 6d.; trebles, 14s. to 14s. 6d.; doubles, 13s. 6d. to 14s.; and singles, 13s. 6d. to 14s., f.o.b. Glasgow.

Luton Public Lighting.—The Luton Town Council have accepted the tender of the Luton Gas Company to supply gas for public lighting for the present year at 1s. 11d. per 1000 cubic feet, subject to the same terms and conditions as to rent of columns, fittings, &c., and repairs to lamps, as those contained in the last contract.

Defeat of the York Corporation Bill.—The poll of the ratepayers of York on the question of the acquisition of the gas-works by the Corporation, for which, as already announced in the "JOURNAL," a Bill has been promoted, took place on the 31st ult., and resulted in the rejection of the proposal. The numbers voting were: Against the Bill, 5346; for it, 3279—majority against, 2067. There were in all 8629 voters (four papers being spoilt), out of an electorate of more than twice this number. The announcement of the result by the Lord Mayor in front of the Mansion House was received with cheers.

Electric Light Failure at Newport (Mon.).—Many of the large and important business premises at Newport, and some of the hotels and private houses, were seriously inconvenienced by a failure of the electric light which took place on the evening of the 1st inst., and lasted for more than an hour. The majority of the tradesmen thus affected suffered considerable financial loss: and probably the only shopkeepers who benefited by the sudden darkness were the purveyors of candles and other means of artificial illumination. The failure was stated to be due to some defective switch gear in one of the substations affecting part of the single-phase alternating supply.

Grantham Gas Company.—The 77th ordinary half-yearly general meeting of this Company was held last Tuesday—Mr. J. G. Thompson, Chairman of the Board, presiding. The report showed that, notwithstanding the increased price of coal, and the extraordinarily heavy expenditure on maintenance of works, the Directors were again able to present a satisfactory balance-sheet, showing a sum of £4581 to the credit of the profit and loss account. Out of this, they recommended that £2000 should be applied in payment of the maximum dividend of 5 per cent. per annum, and that the balance of £2581 should be carried to the next account. The report was adopted.

Rochdale Gas Undertaking.—The Rochdale Corporation, last Thursday, in Committee, had before them a proposal, which they adopted, for stimulating the development of the gas undertaking by opening a central establishment for the display of cooking and heating apparatus, and fixing a good deal of such apparatus free. The idea is not to set up a staff of plumbers at the gas-works, but to give the work to the plumbers of the town. Consumers will have their own choice of plumber; but except in regard to certain apparatus the Corporation will pay for the fixing, and, moreover, for some appliances. There will be no hiring fee. The Local Government Board have notified their sanction to the scheme.

Coleraine Gas-Works Improvements.—The Coleraine Urban District Council have adopted a report of the Gas Committee containing recommendations by Mr. J. D. Smith, the Gas Engineer to the Belfast Corporation, as to improvements to the works and the installation of fresh plant. Mr. Smith considered new retorts necessary, and also a 10,000 cubic feet exhauster; but he thought there was no immediate necessity for a tower scrubber, as had been suggested.

Charge for Power Gas at Warrington.—The Gas Committee of the Warrington Corporation have decided to allow extra discount on the price of gas for motive power only to consumers using gas-engines for more than two hours daily and not less than 70 days per quarter, as follows, according to the tested capacity of the engine when working under full load: Three hours per day, 1d. per 1000 cubic feet; four hours, 2d.; five hours, 3d.; six hours, 4d.; ten hours, 5d.; eleven hours, 6d.

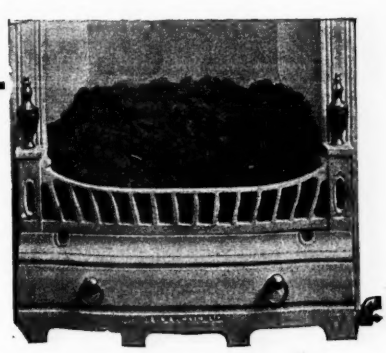
High-Pressure Gas Lighting for Maidstone Declined.—Some weeks ago, the Highways Committee of the Maidstone Town Council had under consideration a letter from Mr. Frank Livesey, the Engineer of the Maidstone Gas Company, submitting a scheme for lighting the High Street on the high-pressure gas system, at an estimated saving of £90 per annum. Particulars of the offer were given in the "JOURNAL" for the 10th of December. At the monthly meeting of the Council last Tuesday, the Committee presented a report upon the offer, and concluded by recommending the Council not to make any alteration. In moving the adoption of the report, Mr. Wallis said the Council would see from it that they would gain nothing by accepting the Company's offer. On the contrary, they would, after March 31 next, incur an additional expenditure of £5 per annum. The Committee were unanimous in their opinion that, under these circumstances, it would not be worth while to suggest any change in the present system of lighting. The report was adopted.

Quality and Price of Shipley Gas.—In consequence of the many complaints which have found their way into the "Yorkshire Observer" in regard to the quality and price of the gas supplied by the Shipley Urban District Council, a representative of that paper had an interview last Thursday with the Clerk of the Council (Mr. I. Lindow), the Chairman (Mr. T. Hill), and other members, and the Gas Engineer and Manager (Mr. H. Blakey), at which the subject was fully discussed. At the close of his able defence of the Council, Mr. Lindow said that if persons who had any reason to complain would first of all communicate their complaints to the Gas Department, giving specific instances, there would be a better opportunity of discovering the fault and applying the remedy. Only in this way could the Committee give satisfaction to anyone. It was impossible to deal with general statements issued broadcast, or with anonymous communications sent to the local Press. So far as the quality of the gas was concerned, the Council were determined that the consumers should be satisfied. As to the complaints of increasing gas bills, the Council could not be held responsible for these unless it were proved that the meter had registered against the consumer.

Malton Gas Company.—At the half-yearly meeting of the Malton Gas Company, the Chairman (Mr. H. W. Pearson) said that the gas consumption continued to increase, despite the competition of the electric light; and the Directors proposed to pay a dividend of 6 per cent., free of income-tax, for the half year. Besides this, they were carrying forward to the next accounts a balance of £2041. Before the advent of the electricity people, a great deal was said about the "monopoly of the Gas Company" (a Company, by-the-way, whose capital was nearly all owned by residents, and whose profits were all spent in the town); but now the town was in the hands of a bigger monopoly—a monopoly which had little or no interest in the district.

South Staffordshire Mond Gas (Power and Heating) Company.—In the report which the Directors of this Company will submit to the shareholders on the 24th inst., they state that during the past year the number of customers supplied increased from 123 to 134, and that the quantity of gas sold was 18 per cent. more than in 1911. The profit on the revenue account is £13,068, whereas in 1911 it was £8856; showing an increase of £4212. After adding the amount brought forward and deducting bank interest and interest on the debenture stock for the year, there is a net profit of £9980, out of which it is proposed to pay a dividend at the rate of 5s. per share (less tax), absorbing £8263, and carry forward a balance of £1717. The Directors consider this progress satisfactory. They have taken £100 each towards their fees for the year, and have decided to forego the remainder. The trunk main is now laid through Wednesbury to Darlaston and Willenhall, and the Directors' anticipations that a considerable number of manufacturers would take advantage of a supply as soon as the Company could give it, have been realized. The Board regret that, owing to difficulties in obtaining structural materials during the past year, the extensions are not yet completed, and many firms are waiting to be connected.

Kingskerswell Gas Supply.—An inquiry was held at Torquay, last Friday, by Mr. R. C. Maxwell, a Local Government Board Inspector, with reference to the Town Council's application for a Provisional Order to enable them to include the parish of Kingskerswell within the limits of the St. Mary Church gas supply. The Town Clerk (Mr. F. S. Hex) explained that there had been negotiations with the Kingskerswell Parish Council, who were willing for gas to be taken into the village. Mr. F. Chalmers, Manager of the St. Mary Church Gas-Works, said he estimated the outlay at £2900, of which £2000 was for mains and compressor, £450 for slot-meters, £50 for ordinary meters, and £200 for incidentals. The length of main to be laid was 3¾ miles. The charges for gas at St. Mary Church were 3s. per 1000 cubic feet for ordinary meters, 2s. 6d. for motive power, and 4s. for slot installations. Kingskerswell consumers would pay 1s. more per 1000 cubic feet in each case. With reference to the question of public lighting, the Town Clerk explained that some members of the Parish Council were opposed to expenditure upon it. Mr. Stooke, Chairman of the Kingskerswell Parish Council, supported the application for the Order, but said he thought the rates should not be increased for the public lighting of the village.



TOP OF THE TREE.

The idea of making a Gas Fire fitting which could be laid in a coal grate, and which closely resembled a coal fire in appearance, originated with our "St. Nicholas" some years ago.

To-day, the "St. Nicholas" embodies many improvements, and is still at the top of the tree in face of the many attempts to emulate its attractive characteristics.

No other fire fitting of its type can compare with the "St. Nicholas" in facility of fixing and unobtrusiveness of Gas Fire fittings.

Its efficiency and beautiful appearance complete the features which go to make it the most popular Fire on the market.

THE "ST. NICHOLAS."

R. & A. MAIN, LIMITED,

WORKS: Gothic Works, EDMONTON, N.; Gothic Ironworks, FALKIRK; and Gothic Works, BIRMINGHAM.
SHOW-ROOMS AND BRANCHES: 25, Princes Street, Oxford Circus, W.; 136, Renfield Street, GLASGOW; 56, Broad Street, BIRMINGHAM; 83, Old Market Street, BRISTOL; 13, Whitworth Street West, MANCHESTER; 8, Exchange Place, Donegall Street, BELFAST; 333, Queen Street, MELBOURNE; and 12, Cunningham Lane, Pitt Street, SYDNEY, N.S.W.

Heating Rooms by Different Methods.—Referring to the recent correspondence in "The Times" on the subject of the "Cost of Domestic Heating," Dr. Leonard Hill, of the London Hospital Medical College, in a letter in the Engineering Supplement last Wednesday, pointed out that "the essential question is not one of units of heat obtained at lowest cost, but units of health. The most healthful, and therefore most economical, method is that one which brings into the room fresh, cool, and moving air, and keeps the human furnace active. The greater the waste of heat up a flue, the more healthy is the condition of the room."

Limerick Gas Affairs.—A recent meeting of the Whole House Committee of the Limerick Corporation had under consideration the report of the Special Committee on the gas undertaking (already referred to in the "JOURNAL," p. 268) regarding the working of the concern, and the allegations of irregularities in administration. It was resolved to recommend the Council to ask the Local Government Board to hold a sworn inquiry into the management of gas affairs in the city during the past ten years—especially in reference to the acceptance of tenders for coal supplies, and the losses arising from the introduction of a new clause in the specification for same, and kindred matters.

Newport (Mon.) Gas-Works Benefit Society.—The thirty-eighth annual dinner in connection with this Society was held last Tuesday evening—Alderman Thomas Canning, J.P., Engineer of the Newport Gas Company, who is the Treasurer, occupying the chair. In proposing the toast of "The Chairman and Board of Directors of the Newport Gas Company," Mr. T. Jones said the relations between the workers and the directorate were most amicable. He coupled with the toast the name of their esteemed Engineer. In responding, Alderman Canning said he had acted as the medium between the men and the Directors; and he hoped to be able to continue in this capacity. He assured them that he would do his best on their behalf in the future. Mr. T. H. Hazell (Secretary of the Company), in proposing "Success to the Newport Gas-Works Benefit Society," stated that during the past year the sum of £150 14s. 7d. had been paid out, as against £132 12s. 10d. in 1911. He said the Society had determined to carry on its work apart from the Insurance Act; and they hoped for its continued success. The Secretary (Mr. J. Whitefield) responded.

At the meeting of the London County Council last Tuesday, the Highways Committee reported that they had arranged for lectures and demonstrations to be given to those employees in the tramways department whose work may bring them into contact with electrically-charged apparatus, in order that they may receive instruction in the treatment of persons suffering from electric shock. The number of men affected is about 300, and they will be divided into classes of about 15 each. The total expenditure will amount to about £42; and for the portion to be incurred during the current financial year there is provision in the maintenance votes for 1912-13.

While engaged last Wednesday in moving a Birmingham gas-main, in connection with some tramway alterations and extensions, five men were overcome by gas, and were discovered lying unconscious in the bottom of the trench. Plenty of help was, of course, at once forthcoming; and on being lifted to the surface, four of the men were restored. The fifth was conveyed to the hospital, where he also was brought round.

Recognizing the importance of ensuring that the Home Office Departmental Committee on Factory Lighting should have before them all available up-to-date information regarding the hygienic aspect of gas for lighting, a letter has been sent by the British Commercial Gas Association to each member of the Committee and the two Secretaries, enclosing copies of the full report by Dr. Rideal on his investigations into the relative hygienic values of gas and electric light, Professor Lewes's lecture at Manchester, and the report by Dr. Toogood on his investigations into the subject at Lewisham Infirmary.

At the offices of the Official Receiver, York Road, Lambeth, S.E., last Wednesday, the first meeting of creditors was held under the failure of Thomas Henry Glascoe, company promoter, patentee, and gas engineer, of Oakcroft, Grove Park, Kent, lately of Eltham Road, Lee, S.E. In August, 1905, debtor was appointed Managing-Director of the National Air-Gas Company, Limited, which was really formed to acquire his gas patents. He continued to act until July 8, 1910, when a Receiver was appointed on behalf of the debenture-holders. Since about November, 1910, debtor had been endeavouring to promote other companies to take over his patents and other things, with, however, very little success. He had not filed his statement of affairs, but disclosed fully secured creditors of more than £2000, with unsecured creditors to the sum of £120. It was decided to adjourn the meeting for fourteen days.

At Paignton, last Friday, four summonses were heard against the Paignton Gas Company in respect of unjust machines and weights. Mr. A. E. Holdwing, the Inspector of Weights and Measures, prosecuted. Mr. S. Vickers, who appeared for the Company, pleaded guilty in respect of one machine, but not the other. The Inspector said there was no suggestion of fraud; it was simply a matter of neglect. He gave particulars of the defects in the machines. Mr. Vickers said coke wore very much indeed anything used in connection with it; and one machine was badly worn. To prove that the unjust action complained of was unintentional, he produced a letter to a firm of machine makers, giving an order for a new machine which had not arrived. The Inspector having given evidence regarding the other machine, which was much out of order, Mr. C. G. Dawson, the Manager of the Company, said this machine was used for loading sacks with coke, the sacks being afterwards placed in waggons and weighed on the weighbridge. He had himself condemned the machine. Witness added that 855 tons had gone over the weighbridge, and there had been no complaints of the weight. The Bench imposed a fine of £2 10s. for each case, considering that there had been carelessness; and the machines and weights were ordered to be forfeited.

R. & J. DEMPSTER, LIMITED,

Leading Makers of SPIRAL GUIDED GASHOLDERS.

MANCHESTER.

Spiral Plates
Steel Tested
Special Rails
Smooth Rollers
Steady Action
Strong Details
Save Capital
Safe and Sure
Stand Severe
Snow Storms and
Stiffest Gales
Successfully.

From a Photograph showing the conversion of a Two-Lift Guide Framed Holder to a Four-Lift Spiral Holder of 3½ million cubic feet capacity, for the Newcastle and Gateshead Gas Company, to Plans and Specifications of W. D. GIBB, Esq., M.Inst.C.E., Engineer.

The Local Government Board have sanctioned a loan of £8000 to meet the expenditure by the Burnley Corporation on gas-mains during the next three years.

Subject to the approval of the Town Council, the Burnley Gas Committee have decided to increase the salary of Mr. J. P. Leather, the Gas Engineer, by £50 per annum.

The Yorkshire and Lincolnshire Tar Distillation Company, Limited, has been formed with a capital of £20,000, in £1 shares, to take over the business of the Company bearing this name carried on at Gunness, Lincolnshire.

During a meeting at the King's Head Hotel, Newport, of the South Wales and Monmouthshire Branch of the National Association of Colliery Managers, the electric light all through the hotel (in common with other premises in the district) failed, and the business had to be conducted by the aid of two or three candles.

The Nelson Corporation Gas Committee, who recently had trouble with their employees, have decided to give all workmen a week's holiday per year with pay. They have also agreed that the pipe-jumpers at the Brierfield works shall be brought up to the same rate of pay as those at the Nelson works—an increase of 5 per cent.—and time-and-a-half has been conceded for overtime.

Some new pumping plant which has been erected by Messrs. James Simpson and Co., Limited, at the water-works of the Leominster Corporation has just undergone a test; and at the last meeting of the Town Council it was stated that the result had been very satisfactory. The engine was specified to raise 30,000 gallons of water per hour; and this quantity had been exceeded by 5000 gallons per hour in a trial extending over eight hours. It was stated that, as the engine had worked well for six months, the ratepayers might rest assured as to its efficiency.

APPLICATIONS FOR LETTERS PATENT.

2128.—Cooke, A. St. J., "Electrically controlled gas-valves." Jan. 27.
2149.—Hopkinson, B., "Gas-engine valves." Jan. 27.
2203.—Stimson, E. F., "Gas-cookers." Jan. 27.
2241.—Pendred, E. E., "Gas-irons." Jan. 28.
2281.—Berlin-Anhaltische Maschinenbau-Akt.-Ges., "Mixing gases of different specific gravities in holders." Jan. 28.
2282.—Tagg, S., "Charging retorts." Jan. 28.
2306.—Wilson, G. J., "Conveying coal." Jan. 28.
2329.—Penicud, J. W., "Thermal pyrometer." Jan. 29.
2349.—Dallas, J., and Storey, I. H., "Suction-gas producers." Jan. 29.
2414.—Keith, J. & G., "Lighting and extinguishing devices." Jan. 29.
2467.—Brown, H., "Measuring gas." Jan. 30.
2481.—Welsbach Light Company, Limited, "Incandescent lighting." A communication from the Deutsche Gas-Gluhlicht Akt.-Ges. Jan. 30.
2543.—Macpherson, A. & J., "Carburetting air." Jan. 31.
2555.—Liversedge, A. J., and Davidson, W. B., "Manufacture of gas." Jan. 31.
2569.—Patterson, W., "Recording the flow of fluids." Jan. 31.
2578.—Boak, R. F., "Gas producers." A communication from C. F. Boak. Jan. 31.
2588.—Horstmann, G. O. H., E. H., A., & S. A., and Edgar, W. T., "Gas-controllers." Jan. 31.
2597.—Liese, H., "Measuring gases." Jan. 31.
2601.—Selas Lighting Company, Limited, and Turner, E., "Valves for burners." Jan. 31.
2640.—Young, F. B., "Lighting and extinguishing device." Feb. 1.

GAS COMPANIES' STOCK AND SHARE LIST.

The Stock Exchange has had a very humdrum sort of week, with scarcely any feature except masterly inactivity. Warlike operations in the East have been resumed; but so closely is the field of action veiled from view, that practically what is going on is a dead secret. The hardy speculator is constrained to curb his ardour and wait a little longer. Thus business has been very quiet and spiritless; and markets, with perhaps the sole exception of Home Rails, have been depressed by lack of support. Another damping factor was the continued tightness of money. On the opening day, the tendency was shifty, and only moderate at best. Consols moved irregularly; losing ⅛ for money and gaining ⅛ for account. Railways were pretty fair; some issues making small advances. Americans jumped about, but were weaker on the whole. Tuesday was very quiet—marking time, and getting very tired of interminable card playing in the Peace-or-War game. Markets in general were dull. Wednesday's business was poor; and small parcels on offer sufficed to depress sensitive markets. Government issues were dull, Rails held on awhile and then gave way, and Americans were weaker. Thursday was dead slow without a breath of animation. Consols were weak and fell ⅛. Rails were irregular, but were not much hurt. Friday was dull and despondent. The gilt-edged class were decidedly weak, and Consols receded another ⅛. Railways showed a shrinkage; but Americans got a little support from Wall Street. Saturday was as quiet as could be, trying to be hopeful and clinging to favourable rumours; but it was a hard job to be cheerful. Consols were unchanged, closing at 74⅛ to 74⅜—a loss of ⅛ in the week. Other markets were as well as could be expected. The Money Market opened quiet, but soon developed a very strong demand, which tightened rates materially. Business in the Gas Market was rather more voluminous than the week before (which is not saying much), and movements were slightly irregular. In Gaslight and Coke issues, the ordinary was moderately dealt in at about the previous week's figures until Saturday, when a transaction was marked at 107, and the quotation was pulled down a point. In the secured issues, the maximum was done at 84½, the preference at 101, and the debenture at 76¾ and 77. South Metropolitan changed hands twice at 118, and then on Saturday was done at 117; and the quotation was lowered ½. Only one transaction was marked in Commercials—a bargain in the 3½ per cent. at 103½. Among the Suburban and Provincial group, Alliance and Dublin realized 76 and 77, Brentford old rose 8, ditto new advanced 5, with business done at 204 to 207 (both these rises being in view of the increased dividend). British marked 45⅛ and 45½, and South Suburban 121—with a rise of 1 in view of the increased dividend. Sheffield "A" rose 1. In the Continental companies, Imperial was done at 173 to 175½, Union at 86 (a rise of 1), ditto preference at 131¼, and European at 19 1/16. Among the undertakings of the remoter world, Bombay realized 6 13/16, Buenos Ayres debenture 93 and 93½, Melbourne 100½, Monte Video from 12⅝ to 13¼ (a rise of ¼), Primitiva from 6½ to 6¾, ditto preference from 5 5/16 to 5 5/16, ditto debenture 96½ and 97, and River Plate debenture 92½.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.	Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.	£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 11	5	Alliance & Dublin Ord.	75—80	..	6 5 0	561,000	Stk.	Aug. 29	10	Liverpool United A .	223—225	..	4 8 11
374,000	"	Jan. 16	4	Do. 4 p.c. Deb.	83—86	..	4 13 0	718,100	"	"	7	Do. B .	161—163	..	4 5 11
280,000	5	Oct. 11	7½	Bombay, Ltd. . . .	6½—7	..	5 7 2	306,083	"	Dec. 30	4	Do. Deb. Stk.	98—100	..	4 0 0
50,000	10	Aug. 29	15	Bourne-) 10 p.c. .	29—30	..	5 0 0	63,480	Stk.	Jan. 16	3	Maidstone 3 p.c. Deb.	68—70	..	4 5 9
332,000	10	"	7	mouth Gas) B 7 p.c. .	15⅝—16¼	..	4 6 2	75,000	5	Nov. 28	6	Malta & Mediterranean	4⅛—4⅜	..	6 6 4
75,000	10	"	6	and Water) Pref. 6 p.c.	14—14½	..	4 2 9	250,000	100	Oct. 1	4½	Met. of Melbourne) 4½ p.c. Deb.	99—101	..	4 9 1
880,000	Stk.	Aug. 14	14†	Brentford Consolidated	265—270	+8	5 3 8								
330,000	"	"	11†	Do. New . .	205—210	+5	5 4 9	541,920	20	Oct. 30	3½	Monte Video, Ltd. . .	12½—13	+¼	5 7 8
50,000	"	"	5	Do. 5 p.c. Pref. .	115—117	−1	4 5 6	1,775,892	Stk.	July 26	4⅜	Newc'tle&G'tesh'd Con.	102¼—103½	..	4 4 6
206,250	"	Dec. 12	4	Do. 4 p.c. Deb. .	94—96	..	4 3 4	529,705	Stk.	Dec. 30	3½	Do. 3½ p.c. Deb.	86—87	..	4 0 6
218,230	Stk.	Aug. 29	11	Brighton & Hove Orig.	210—215	..	5 2 4	55,940	10	Aug. 29	7 7/10	North Middlesex 7 p.c.	13⅝—14½	..	5 1 5
244,200	"	"	8	Do. A Ord. Stk. .	152—155	..	5 3 3	300,000	Stk.	Nov. 28	8	Oriental, Ltd. . . .	125—130	..	6 3 1
530,000	20	Sept. 27	12½	British	44½—45½	..	5 9 11	60,000	5	Sept. 27	10	Ottoman, Ltd. . . .	8¼—9⅜	..	5 14 8
120,000	Stk.	Dec. 30	4	Do. 4 p.c. Deb. Stk.	89—91	..	4 7 11	60,000	50	Aug. 14	13	Portsea, Island B . .	127—130	..	5 0 0
245,771	Stk.	"	4	Buenos Ayres 4 p.c. Deb.	92—94	..	4 5 1	100,000	50	"	12	Do. C . .	124—127	..	4 14 6
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—	249,980	5	Oct. 11	8	Primitiva Ord. . . .	6⅜—6¼	+⅛	5 16 5
100,000	10	—	—	Do. 4½ p.c. Pref. .	3½—4½	..	—	499,960	5	Dec. 30	5	" 5 p.c. Pref. .	5—5¼	..	4 15 8
100,000	Stk.	Dec. 30	4½	Do. 4½ p.c. Deb. Stk.	71—75	..	6 0 0	521,600	100	Dec. 2	4	" 4 p.c. Deb. .	96—98	..	4 1 8
157,150	Stk.	Aug. 29	5	Chester 5 p.c. Ord. . .	110—112	..	4 9 3	346,198	Stk.	Dec. 30	4	River Plate 4 p.c. Deb.	92—94	..	4 5 1
1,513,280	Stk.	Aug. 29	5/9/4	Commercial 4 p.c. Pref.	106—108	..	5 1 2	275,000	5	Apl. 12	12	San Paulo, Ltd. . . .	13—14	..	4 5 9
560,000	"	"	5½	Do. 3½ p.c. do. .	102—104	..	5 2 6	150,000	10	Sept. 27	6	Do. 6 p.c. Pref. .	11½—12	..	5 0 0
475,000	"	Dec. 12	3	Do. 3 p.c. Deb. Stk.	71—73	..	4 2 2	125,000	50	Jan. 2	5	Do. 5 p.c. Deb. .	49—51	..	4 18 0
800,000	Stk.	"	4	Continental Union, Ltd.	84—87	+1	4 12 0	135,000	Stk.	Aug. 29	10	Sheffield A	233—235	+1	4 5 1
200,000	"	"	7	Do. 7 p.c. Pref.	130—132	..	5 6 1	209,984	"	"	10	Do. B	232—234	..	4 5 6
492,270	Stk.	—	5⅜	Derby Con. Stk. . . .	124—125	..	4 12 0	523,500	"	"	10	Do. C	229—231	..	4 6 7
55,000	"	—	4	Do. Deb. Stk. .	103—105	..	3 16 2	90,000	10	Sept. 27	7½	South African . . .	9½—10½	..	7 2 10
1,002,180	10	Jan. 16	10	European, Ltd. . . .	18½—19½	..	5 2 7	6,429,825	Stk.	Aug. 29	5/9/4	South Met., 4 p.c. Ord.	116⅝—117½	−½	4 12 2
16,415,840	Stk.	Aug. 14	4/17/4	Gas) 4 p.c. Ord. . .	106—108	−1	4 10 3	1,295,445	"	Jan. 16	3	Do. 3 p.c. Deb.	74—77	..	3 17 11
2,600,000	"	"	3½	light) 3½ p.c. max. .	83—85	..	4 2 4	209,820	Stk.	Aug. 14	8½	South Shields Con. Stk.	164—166	..	5 2 5
4,062,295	"	"	4	and) 4 p.c. Con. Pref.	100—102	..	3 18 5	952,795	Stk.	Aug. 14	6†	S'th Suburb'n Ord. 5 p.c.	119—122	+1	4 18 4
4,674,850	"	Dec. 12	3	Coke) 3 p.c. Con. Deb.	75—78	..	3 16 11	60,000	"	"	5	Do. 5 p.c. Pref. .	117—119	..	4 4 0
258,740	Stk.	Sept. 13	5	Hastings & St. L. 3½ p.c.	91—93	..	5 7 6	117,058	"	Dec. 30	5	Do. 5 p.c. Deb. Stk.	118—120	..	4 3 4
82,500	"	"	6½	Do. do. 5 p.c.	—	..	—	594,740	Stk.	Nov. 14	5	Southampton Ord. . .	102—105	..	4 15 3
70,000	10	Oct. 11	11	Hongkong & China, Ltd.	16—16½	..	6 13 4	120,000	Stk.	Aug. 14	7½	Tottenham) A 5 p.c. .	142—145	..	5 0 0
131,000	Stk.	Sept. 13	7½	Ilford A and C . . .	154—157	..	4 17 1	483,940	"	"	5½	and) B 3½ p.c. .	115—117	..	4 18 3
65,780	"	"	6½	Do. B	122—124	..	4 18 9	149,470	"	Dec. 30	4	Edmonton) 4 p.c. Deb.	92—94	..	4 5 1
65,500	"	Dec. 30	4	Do. 4 p.c. Deb. . .	89—91	..	4 7 11	182,380	10	"	5	Tuscan, Ltd.	7⅜—8¼	..	6 1 3
4,940,000	Stk.	Nov. 14	9	Imperial Continental .	173—178	..	5 1 1	149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	96—98	..	5 2 0
1,235,000	Stk.	Aug. 14	3½	Do. 3½ p.c. Deb. Red.	87—89	..	3 18 8	236,476	Stk.	Aug. 14	5	Tynemouth, 5 p.c. max.	115—115½	..	4 6 7
200,242	Stk.	Aug. 29	6	Lea Bridge Ord. 5 p.c. .	122—125	..	4 16 0	255,636	Stk.	Aug. 29	6⅞	Wands-) B 3½ p.c. . .	140—143	..	4 16 2
								85,766	"	Dec. 30	3	worth) 3 p.c. Deb. Stk.	68—70	..	4 5 9

† Next dividend will be at this rate.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

SECRETARY AND MANAGER. Warwick Gas Company. Applications by Feb. 18.
TECHNICAL ASSISTANT. Nelson Gas Department.
DRAUGHTSMAN. Widnes Corporation.
OUTDOOR INSPECTOR. Weston-super-Mare Gas Co.
TRAVELLER. Sutherland Meter Company.
TRAVELLERS (Coal). No. 5693.

Meetings.

BARNET GAS AND WATER COMPANY. Holborn Restaurant. Feb. 27. One o'clock.
BRENTFORD GAS COMPANY. St. Ermin's Hotel. Feb. 21. 2.30 o'clock.
CHICHESTER GAS COMPANY. Works Offices. Feb. 25. One o'clock.
HARROW AND STANMORE GAS COMPANY. Holborn Restaurant. March 3. Twelve o'clock.
HORLEY GAS COMPANY. Great Eastern Hotel. Feb. 28. 3.30 o'clock.
NORTH MIDDLESEX GAS COMPANY. 5, Great Winchester Street, E.C. Feb. 24. 2.30 o'clock.
RIDDINGS GAS COMPANY. Nos. 6 and 7, Queen Street, E.C. Feb. 27. 3.30 o'clock.
SOUTHGATE GAS COMPANY. 5, Great Winchester Street. Feb. 27. 3.45 o'clock.

Patent for Disposal or Exploitation.

SELF INTENSIFYING GAS LAMP. No. 5696.

Plant, &c. (Second-Hand), For Sale.

RETORTS AND FITTINGS, CONDENSERS, &c. Sutton Gas Company.
RETORTS, BENCH FITTINGS, &c., CONDENSERS, SCRUBBER, WASHER, EXHAUSTERS, PURIFIERS, STATION METER, &c. Newport (Mon.) Gas Company. Tenders by March 5.

Stocks and Shares.

HARROW AND STANMORE GAS COMPANY. London Mart. March 4.
LOWESTOFT WATER AND GAS COMPANY. London Mart. March 4.
TENDRING HUNDRED WATER COMPANY. London Mart. March 4.

TENDERS FOR

Boilers.

LEICESTER GAS DEPARTMENT. Tenders by Feb. 14.

Brass Goods.

NELSON GAS DEPARTMENT. Tenders by Feb. 18.

Coal.

NELSON GAS DEPARTMENT. Tenders by Feb. 18.

Fire-Clay Goods, Retort Setting, &c.

TODMORDEN GAS DEPARTMENT.

General Stores.—Ironmongery, Paints, Oils, Steel, Iron Nuts and Bolts, Asbestos Goods, Tools, &c.

DEVONPORT GAS DEPARTMENT. Tenders by Feb. 22.
NELSON GAS DEPARTMENT. Tenders by Feb. 18.
STOCKTON-ON-TEES CORPORATION. Tenders by Feb. 19.

Lighting Goods (Burners, Mantles, Glassware, &c.).

DEVONPORT GAS DEPARTMENT. Tenders by Feb. 22.
DUBLIN PUBLIC LIGHTING DEPARTMENT. Tenders by Feb. 13.
WALTHAMSTOW STREET LIGHTING DEPARTMENT. Tenders by Feb. 28.

Pipes, &c.

DEVONPORT GAS DEPARTMENT. Tenders by Feb. 22.

Tar and Liquor.

HAWORTH URBAN DISTRICT COUNCIL. Tenders by Feb. 24.
NELSON GAS DEPARTMENT. Tenders by Feb. 18.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office NOT LATER than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or stoppages of, PERMANENT ADVERTISEMENTS should be received by the FIRST POST on SATURDAY.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

TERMS OF SUBSCRIPTION to the "JOURNAL."

United Kingdom: One Year, 21s.; Half Year, 10s. 6d.; Quarter, 6s. 6d.
Payable in advance. If credit is taken, the charge is 25s. a year.
Abroad (in the Postal Union): £1 7s. 6d., payable in advance.

All Communications, Remittances, &c., to be addressed to WALTER KING, 11, BOLT COURT, FLEET STREET, LONDON, E.C.
Telegrams: "GASKING FLEET, LONDON." Telephone: P.O. 1571a Central.

OXIDE OF IRON.

O'NEILL'S OXIDE
For GAS PURIFICATION.
LARGEST SALE OF ANY OXIDE.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

GAS PURIFICATION & CHEMICAL CO., LD.,
PALMERSTON HOUSE,
OLD BROAD STREET, LONDON, E.C.

WINKELMANN'S
"VOLCANIC" FIRE CEMENT.
Resists 4500° Fahr. Best for GAS-WORKS.
ANDREW STEPHENSON, 182, Palmerston House, Old Broad Street, London, E.C. "Volcanism, London."

POULTONS & TIMMIS, Ltd.

CARBONIZING and Boiler Setting
Engineers, Complete Installations undertaken.
Their Retort Settings are THE best.
GUARANTEED RESULTS.
Registered Office: READING. Telephone: 265 Reading.
London Office: HALTON HOUSE, 20/23, HOLBORN.
Telephone: 2619 Holborn.
Manchester Office: 55, CROSS STREET.

HIGH PRESSURE GAS.

COMPLETE LIGHTING INSTALLATIONS supplied by
JAMES MILNE AND SON, LIMITED,
EDINBURGH, GLASGOW, LONDON, LEEDS.

SULPHURIC ACID.

SPECIALLY prepared for Sulphate of AMMONIA Makers by
CHANCE AND HUNT, LIMITED.
Works: OLDBURY, WEDNESBURY, AND STAFFORD.
Address Correspondence and Inquiries to OLDBURY, WORCS.
Telegrams: "CHEMICALS, OLDBURY."

HUTCHINSON BROTHERS, Ltd.,
FALCON WORKS, BARNSLEY,
MANUFACTURERS OF
GAS METERS (ordinary and prepayment).
MAIN COCKS, &c.
"FALCON" INVERTED LAMPS, for street lighting.
"ZENITH" INVERTED LAMPS, for outside shop, &c., lighting.
"FALCON" INVERTED BURNER LANTERNS.
SQUARE STREET LANTERNS.
BURNERS and CONVERSION SETS for street lanterns, &c., &c.

J. & J. BRADDOCK (Branch of Meters Limited), Globe Meter Works, OLDHAM, and 45 & 47, Westminster Bridge Road, London, S.E.
WET AND DRY GAS-METERS, PREPAYMENT METERS, STATION METERS AND GOVERNORS.
REPAIRS RECEIVE PROMPT ATTENTION,
Telephones: 815 Oldham, and 2412 Hop, London.
Telegrams—
"BRADDOCK, OLDHAM," and "METRIQUE, LONDON."

DUTCH OXIDE OF IRON.

SPENT OXIDE PURCHASED IN ANY DISTRICT.

THE First Dutch Bogore Co., Ltd.,
NYMEGEN, HOLLAND.
GENERAL MANAGERS—
London and South of England:
W. T. P. CUNNINGHAM,
13, Arcadian Gardens, Wood Green, LONDON, N.
North of England, Midlands, and Wales:
J. BROWN & CO., LTD., Savile Town, DEWSBURY.
Scotland and Ireland:
J. B. MACDERMOTT, 11, Bothwell St., GLASGOW.

ENQUIRIES SOLICITED.

FOR Gas-Works Plant of Every Description; also SULPHATE OF AMMONIA and SULPHUR RECOVERY PLANTS.
C. & W. WALKER, LIMITED,
DONNINGTON, NEWPORT, SALOP.

SPENCER'S PATENT HURDLE GRIDS.

THE very best Patent Grids for Holding Oxide Lightly.
See Illustrated Advertisement, p. 428.

SULPHURIC ACID.

SPECIALLY prepared for the Manufacture of SULPHATE OF AMMONIA.
SPENCER CHAPMAN & MESSEL, LTD.,
with which is amalgamated WM. PEARCE & SONS, LTD., 36, Mark Lane, LONDON, E.C. Works: SILVERTOWN.
Telegrams: "HYDROCHLORIC, FEN. LONDON."
Telephone: 1588 AVENUE (3 lines).

D. ANDERSON AND COMPANY,
GAS LIGHTING ENGINEERS AND CONTRACTORS.
18 & 20, FARRINGDON ROAD, LONDON, E.C.
Telegrams: "DACOLIGHT LONDON." Telephone: 2336 HOLBORN.

J. E. C. LORD, Ship Canal Tar-Works, Weaste, Manchester. Pitch, Creosote, Benzols, Toluol, Naphtha, Pyridine, all kinds of Cresylic Acid, Carbolic Acid, Sulphate of Ammonia, &c.

OXIDE OF IRON.
SPENT OXIDE PURCHASED.
BALE'S FIRE CEMENT.
PAINT FOR GAS-WORKS.
"KLE ENOFF." THE COOKER CLEANER.
BALE & CHURCH, LTD.
5, CROOKED LANE, LONDON, E.C.

TAR WANTED.
THOMAS HORROCKS & SONS, LTD.,
Albert Chemical Works,
GRANT STREET, MILES PLATTING, MANCHESTER.
Pitch, Creosote, Brick and Fuel Oils, Benzol, Solvent Naphtha, Carbolic, Sulphate of Ammonia.

PRESSURE REDUCERS.
ACTION—SIMPLE, AUTOMATIC, FRICTIONLESS.
THE THING for your Hilly Districts.
Write to-day for illustrated Sheet—
JAMES MILNE AND SON, LIMITED,
EDINBURGH, LONDON, GLASGOW, LEEDS.

HYDRATED OXIDE OF IRON.
PREPARED from Pure Iron.
Twice as rich as Bog Ore.
Gives no back Pressure.
The Cheapest in the Market.
READ HOLLIDAY AND SONS, LTD., HUDDERSFIELD.

SULPHATE OF AMMONIA
SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We Guarantee promptness with efficiency for Repairs.
JOSEPH TAYLOR AND CO., CENTRAL PLUMBING WORKS, BOLTON.
Telegrams: "SATURATORS BOLTON." Telephone 0848.

AMMONIACAL Liquor Wanted.
CHANCE AND HUNT, LTD., Chemical Manufacturers, OLDBURY, WORCS.
Telegrams: "CHEMICALS."

"GAZINE" (Registered in England and Abroad). A radical Solvent and Preventative of Naphthalene Deposits, and for the Automatic Cleaning of Mains and Services.
It is also used for the Enrichment of Gas.
Manufactured and Supplied by C. BOURNE, West Moor Chemical Works, KILLINGWORTH, or through his Agents, F. J. NICOL & CO., Pilgrim House, NEWCASTLE-ON-TYNE.
Telegrams: "DORIC," Newcastle-on-Tyne. National Telephone No. 2497.

GAS PLANT for Sale—We can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
FIRTH BLAKELEY, SONS, AND COMPANY, LIMITED, Church Fenton, near LEEDS.